MODERN PLASTICS

MARCH 1945

R v.22 2 Mar-Aug. 1945

WORTH GETTING "STEAMED-UP" ABOUT

Designed by Brooks Stevens, molded by Raymond Laboratories for Spartan Co., Minneapolis

The Spartan vaporizer illustrated above is a brand new development in humidifying equipment. Entirely automatic, this vaporizer holds a full half-gallon of water and gives off steam immediately even though the water is ice cold. The unusual design and ingenious mechanical principle of this unit typify the progressiveness of American industry in developing new products and improving old ones with plastics.

The ever-increasing usage of Durez phenolic molding compounds by manufacturers throughout industry is due directly to two reasons.

First is the unusual versatility of the phenolics. These most versatile of all plastics possess such desirable properties as excellent moldability, highest dimensional stability, diversity of finishes, dielectric strength, and resistance to heat, moisture, acids and alkalies.

Second is the rich background which Durez technicians have acquired through *specializing* in the production of phenolics during the past quarter century. They have participated in the successful development of thousands of different products, supplying in each case a plastic that fitted the job. In many instances, the finished product was not all-plastic but consisted of a combination of plastic and metal. A good example of this is the above illustrated Spartan vaporizer. The lower container, inner elements, knobs and handles were molded from a Durez phenolic compound. The cover is a satin-finish aluminum stamping.

Undoubtedly you are working out the development plans for a product which is scheduled for post-victory marketing. Naturally you are considering the use of plastics in this connection. The benefits of our broad experience plus the wealth of data collected in our files are at your disposal at all times. Durez Plastics & Chemicals, Inc., 263 Walck Road, North Tonawanda, N. Y.

DUREZ

PHENOLIC RESINS

- MOLDING COMPOUNDS
- INDUSTRIAL RESINS
- OIL SOLUBLE RESINS

PLASTICS THAT FIT THE JOB

Tech

AT THE GAME TABLE
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PLAYS AN IMPORTANT "HAND"
Beyond the thrill of competitive fun, you derive infinitely more pleasure from your game when the pieces-of-play are produced from Catalin, the gem of plastics. Catalin is strong, richly colorful. Its surface is brilliant and smooth. Inexpensively cast and interpretively fabricated, Catalin captures and restores for modern-day enjoyment the exquisite artistry which the masters of old gave to the creation of their gaming pieces.
Postwar projections for Catalin in games, and many other fields, already indicate a volume far in excess of its pre-war preference. For that reason and for the purpose of helping manufacturers to plan ahead, the Catalin staff invites your inquiry!
CATALIN CORPORATION
ONE PARK AVENUE, NEW YORK 16, N. Y.
Catalin
CAST RESINS • LIQUID RESINS
MOLDING COMPOUNDS

MODERN PLASTICS

AND PLASTICS

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L. B. CHAPPELL
427 West 5th St., Los Angeles 13, Calif.

All editorial contents bearing on military subjects have been released for publication by the Armed Services.

MODERN PLASTICS is regularly indexed in the Industrial Arts Index.

Member Audit Bureau of Circulations

EXECUTIVE and EDITORIAL OFFICES: 122 E. 42nd St., New York 17, N. Y. WASHINGTON 6, D. C., OFFICE: 625 Colorado Bldg., 14th & G Sts. Published the 20th of the preceding month by Modern Plastics, Incorporated. Publication Office, Twentieth and Northampton Sts., Easton, Pa. Subscription price $5.00 per year, $8.00 for 2 years in U. S., its possessions and South America. Canadian subscriptions $5.50 per year, $9.00 for 2 years; all other countries $6.00 per year, $10.00 for 2 years, payable in American money or its equivalent. Price 50¢ per copy.

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Printed in U. S. A. Entered as second class matter. May 28, 1940, at the Post Office at Easton, Pa., under the act of March 3, 1879. Member of the Audit Bureau of Circulations. Back numbers 3 months or more preceding current issues, when available, $1.00 each.

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With Geon it's the *combination* of properties that counts

THE processor who coated this lightweight fabric with GEON really "made something of it". For with the application of one of the GEON polyvinyl raw materials he created a fabric possessing many unusual and desirable properties in a *combination* that was *planned* to meet specific needs.

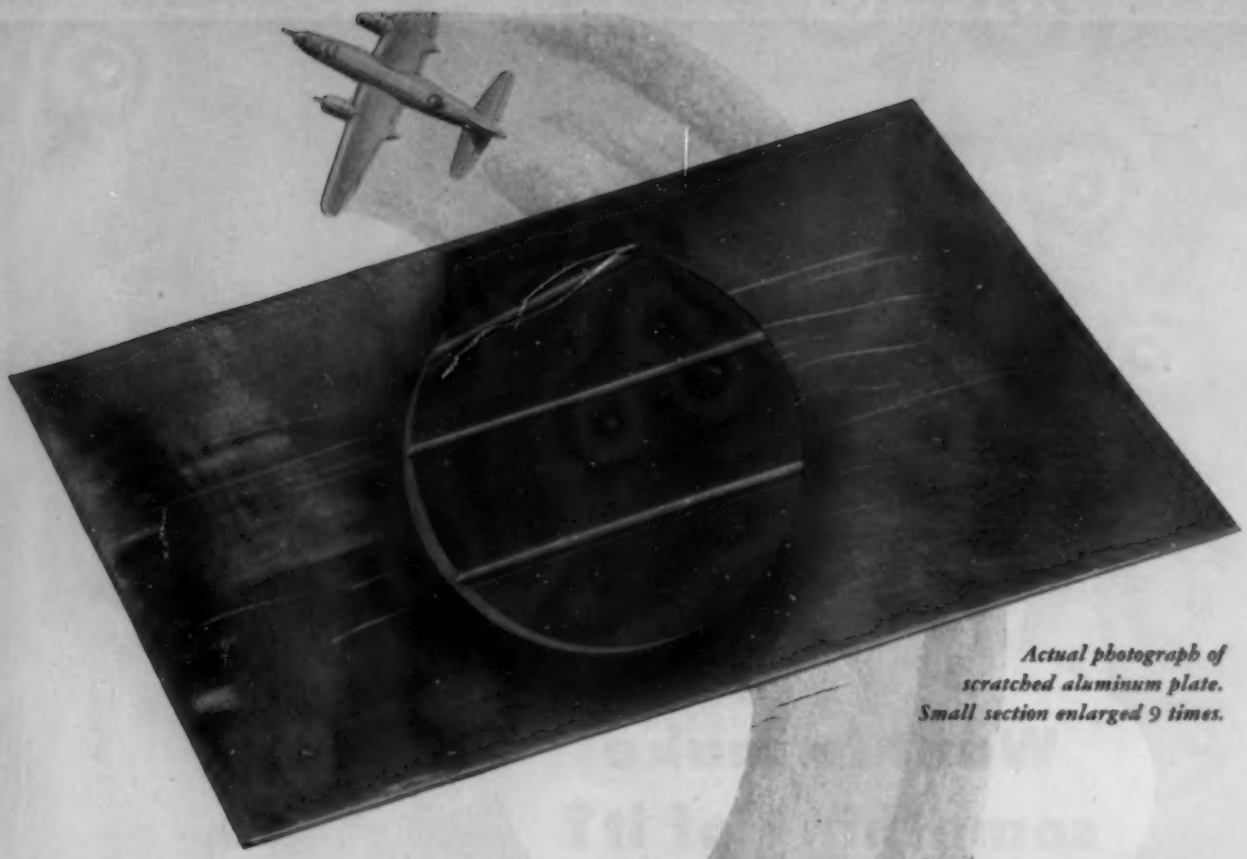
This same type of planning is possible for engineers and designers in the plastics industry just as it is in the packaging, paper, textiles, shoes, upholstery and many others. For more than 30 distinct properties may be had in an almost unlimited number of *combinations*. For example, products made of GEON may be made to resist water, heat, cold, aging, wear, abrasion, sunlight, chemicals and many other destructive factors. They can be made tasteless, odorless, non-toxic. They may be brilliantly—or softly—colored.

This coated fabric is just one example of what can be done with the GEONS. For in addition to serving as a coating for fabric or paper, the GEONS can be calendered or cast into sheet or film. They can be extruded, pressure or injection molded. Products made of GEON may be flexible or rigid. Doesn't all this suggest some new—or old—product that *you* want to make out of GEON?

Right now all the GEONS are subject to allocation by the War Production Board. Limited quantities can be had for experiment. For more complete information write Department II-3, Chemical Division, The B. F. Goodrich Company, 324 Rose Building, Cleveland 15, Ohio.

Geon
Polyvinyl Materials

CHEMICAL DIVISION
The B. F. Goodrich Company
324 ROSE BUILDING • CLEVELAND 15, OHIO



Actual photograph of scratched aluminum plate. Small section enlarged 9 times.

what happens to a SCRATCH ...at 400 miles per hour?

The tiniest surface scratch . . . so small you might never notice it . . . can often grow big and serious under the constant shock and pounding of *vibration.* For a scratched part is a weak part that may open the door to fatigue failure.

To minimize this possibility in their products, experienced aircraft engineers use forming blocks fabricated from Laminated INSUROK, Grades T-601 and CG. They have found that by using this precision plastic they can *cut costs, save time,* and *do better work* . . . both in rubber pad and direct forming of lighter metals.

Laminated INSUROK does not mar materials; it is approximately half the weight of aluminum; therefore easier to handle regardless of size; and oils, greases and other lubricants have no deteriorating effects. Grade T-601 can be fabricated with high-speed tools. Grade CG, because of its graphitic content, gives longer life than T-601 or usual canvas laminates, hardwoods or hardboard materials. It can be fabricated with Carboloy tools.

Whether your products are designed for war or peace . . . INSUROK forming blocks can benefit you in many important ways. *With Laminated INSUROK sheet stock, you can make low-cost dies in your own plant . . . or Richardson Plasticians will make them for you.* Write us today for information.

Forming Dies of Laminated INSUROK, shown here through the courtesy of Republic Aviation Corporation.

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PAPER COILFORMS made of three layers of 0.004 inch gummed kraft paper, with vulcanized fiber flanges, anchored by fillet of phenolic cement.

NYLON COILFORMS injection molded of Du Pont FM-1 nylon molding powder by Boonton Molding Co. Boonton, N. J., for Control Instrument Co., Bklyn., N.Y.

FOR PLASTICS, CONSULT DU PONT

ADVANTAGES—For maximum sensitivity and output in Navy sound-powered telephone units, many turns of wire must be placed as close to an armature as possible. Though the wall of the nylon core is only 0.012 inch thick, it maintains, under test, dimensional and dielectric stability at temperatures ranging from −60° F. to +400° F. According to the manufacturer, operations have been reduced from six to three, thus contributing to cutting the cost of the finished coilform by 50% with the use of nylon. With the old materials only about 10% yield was obtained; with nylon the average yield is better than 95%. With a two-cavity die, injection-molded nylon has increased coilform production per man 800 to 1000%.

AVAILABILITY—The current supply of Du Pont nylon is available only for war applications and experimental work. For information write E. I. du Pont de Nemours & Company (Inc.), Plastics Department, Arlington, New Jersey.

MASS PRODUCTION FOR THE

MINUTE MEN

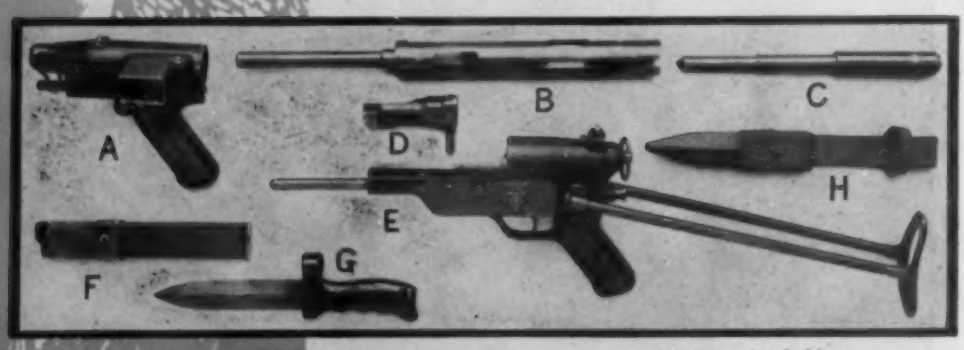
OF "DOWN UNDER"

★

When Australia was threatened by invasion, she direly needed hundreds of thousands of automatic rifles with which to arm her civilians. Spreading Jap tentacles made it imperative that these much-needed weapons be manufactured right in Australia.

A prompt solution to the problem was provided by the deadly, rapid-fire rifle pictured here. Reed-Prentice machines made possible the mass production of plastic parts for the huge quantities of weapons required.

Reed-Prentice "Engineered Service" already is helping manufacturers solve their plastic production problems of tomorrow. A complete analysis of plastic possibilities in your business gladly will be furnished by Reed-Prentice experts. This comprehensive service is supplemented by plastic mold design and manufacture . . . and is augmented further by the largest selling line of plastic molding machines in America. Write for details concerning Reed-Prentice Engineered Service today.



(a) Magazine holder
(b) Barrel and receiver
(c) Main spring sheaths
(d) Bolt and firing pin
(e) Frame
(f) Magazine
(g) Bayonet
(h) Scabbard

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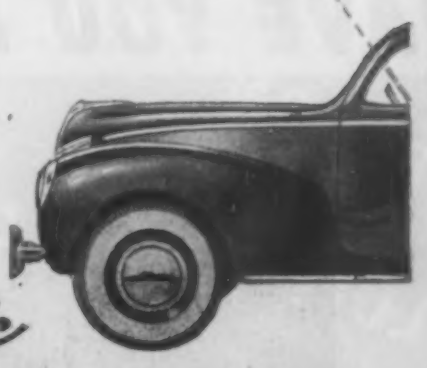
Lumarith color provides quick identification of parts and controls in aircraft, electrical switchboards and plant machines. Lumarith gives function to color — as in the Air Corps Blind Flying Equipment—where orange colored Lumarith windshield and blue Lumarith goggles restrict student's vision to his instruments. The instructor, wearing no goggles, sees perfectly through the orange colored windshield.

The Lumarith group brackets the thermoplastic field in toughness, tensile strength and stability. If you would like to know more about these versatile materials, write for designer's booklet. Celanese Plastics Corporation, *a division of Celanese Corporation of America*, 180 Madison Avenue, New York 16, N. Y.



*REG. U. S. PAT. OFF.

A Celanese Plastic*

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We temper
test-tube findings
in the retort
of our experience
as world's largest producer
of injection-molded
heavy section pieces.
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slide-rule answers
in the light
of any plastic's or process's
past performance.
And we season our findings
with a dash
of scientific inspiration.
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Finer plastic products.

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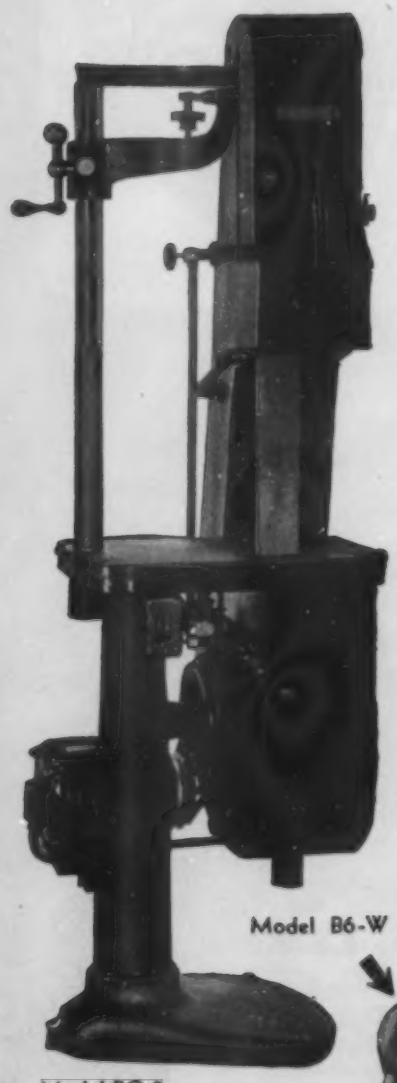
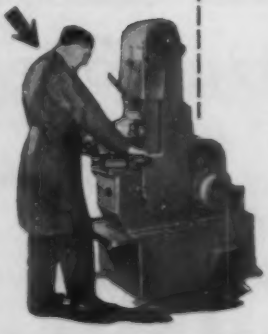


Model B6-W



Model BG-8

For large scale precision work on identical parts. Operating wet, the belt adheres to true-flat platen backing. Thus, micro-cuts can be taken off to close limits, with exact uniformity, for long or short production runs. Production can be further increased by using fixtures mounting a gang of pieces at one presentation to abrasive.

Here's a machine that will take over many jobs from work-swamped machines and reduce bench operations to a minimum. It's fast, accurate, versatile—and a genuine time and money-saver! The Wet-or-Dry Belt Surfacer is a natural for the plastics industry—as more and more manufacturers are learning every day. It finishes from 5 to 25 times faster than many common methods—and, even with inexperienced operators, reduces waste and rejects! The flexible abrasive belt holds contours easily—finishes curves or irregular surfaces. *This plastics finishing method eliminates flow, discoloration, warping, and dust!*

- *REMOVES* GATES—PARTING LINES—FLASHINGS!
- *FINISHES* ROUGH SPOTS!
- *SMOOTHES* MOLDED DEFECTS!
- *MACHINES* TRUE FLATS!
- GIVES ALL-OVER FINISH TO SPHERES, CYLINDERS!

With a simple platen behind the belt, it finishes identical surfaces *uniformly* on repeated operations. Most jobs can be surfaced free-hand!

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Company.....

Street.....

City.....State.....

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PLASTICS

One of many special application presses in our plant, this large side ram press will produce certain types of plastic moldings more efficiently and more economically, with simpler and cheaper dies than possible in a standard type of press.

Now 100% on war work, but when peace comes again this press will be available once more for the production of moldings requiring heavy side draws.

ARMY E NAVY

THE BRYANT ELECTRIC COMPANY

HEMCO PLASTICS DIVISION

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A subsidiary of Westinghouse Electric & Manufacturing Co.

PLASTICS and Electricity

are life partners

Plastics and electricity grew up together. Each furthered the progress of the other. Nowadays hardly an electric or electronic device is made without some plastic parts.

The happy marriage of plastics and electricity has benefited from the stimulus of war production. New plastic materials with improved electrical properties have been developed. Advanced design and production methods give greater scope to the use of molded plastic parts.

This is a good time to re-examine the use of plastics in your product. A slight modification in materials or design may give you better performance, lower assembly cost, improved appearance . . . or some other important postwar advantage such as lighter weight or better heat insulation. We will be glad to have you submit your product or plans to our engineering department for a preliminary appraisal . . . made without cost or obligation. MOLDED PRODUCTS COMPANY, 4533 W. Harrison St., Chicago 24, Ill.

PLASTICS DIVISION

MOLDED MPc PRODUCTS

Complicated aircraft duct saves man-hours on the production line because ducts are not dented or permanently deformed during installation.

The combination of Fiberglas textiles (fine fibers of glass twisted into yarn and woven into fabrics) and certain contact or low-pressure resins has resulted in a new and different structural material. It has many significant properties and qualities which excel those of any material previously available for commercial use.

As applied to the production of formed plastics parts, Fiberglas textiles, used as a reinforcement, assure:

1. **Simplified fabrication**
2. **Higher impact strength**
3. **Better strength-to-weight ratio**
4. **Greater rigidity**
5. **Dimensional stability**

In the production of dies and jigs, structural forms and complicated parts, the necessity of metal dies and machining is avoided, important time and cost savings are effected. For example, the aircraft duct, illustrated above, is a one-piece fabrication, not an assembly of several parts.

Impact strength from five to ten times that previously obtained in laminates is now being attained through Fiberglas reinforcement. The glass fibers have great flexibility and stand high stresses without permanent deformation. They are not affected by moisture changes within the range of commercial usage, remaining dimensionally stable.

Possibly these properties suggest an application to the product you are now manufacturing for war, or are planning for postwar markets. Owens-Corning Fiberglas Corporation does not manufacture resins or finished laminates but will be glad to furnish experimental samples of Fiberglas and data on techniques in its use with plastics. Write: *Owens-Corning Fiberglas Corporation, 1876 Nicholas Bldg., Toledo 1, Ohio. In Canada, Fiberglas Canada Ltd., Oshawa, Ontario.*

FIBERGLAS . . . A BASIC MATERIAL

*T. M. Reg. U. S. Pat. Off.

Chemaco Ethyl Cellulose

A HIGH FLYING PLASTIC . . .

FOR SUB-ZERO IMPACT STRENGTH

Chemaco Ethyl Cellulose is the toughest of the cellulose family. Its impact strength at low temperatures provides a rugged material to meet extraordinary demands when sub-zero temperatures are a factor in operating conditions. Chemaco Ethyl Cellulose is noteworthy for its shatterproof qualities and extreme dimensional stability over a wide range of temperatures.

It offers to the aviation and automotive industries, to hardware and household appliance manufacturers, a tough, dependable plastic that will take hard usage. It is the ideal material for injection molded flashlight cases, vacuum cleaner housings, tool handles, refrigerator parts, coil cores and non-chipping extruded trim. It is available in a wide range of colors.

Chemaco engineers are at your service to help you in determining which material can best meet rigid military and industrial specifications. Other Chemaco molding powders include High Acetyl Cellulose Acetate, Polystyrene and Vinyl Compounds as well as Ethyl Cellulose.

Chemaco Corporation

(A subsidiary of Manufacturers Chemical Corporation)

Berkeley Heights, N. J.

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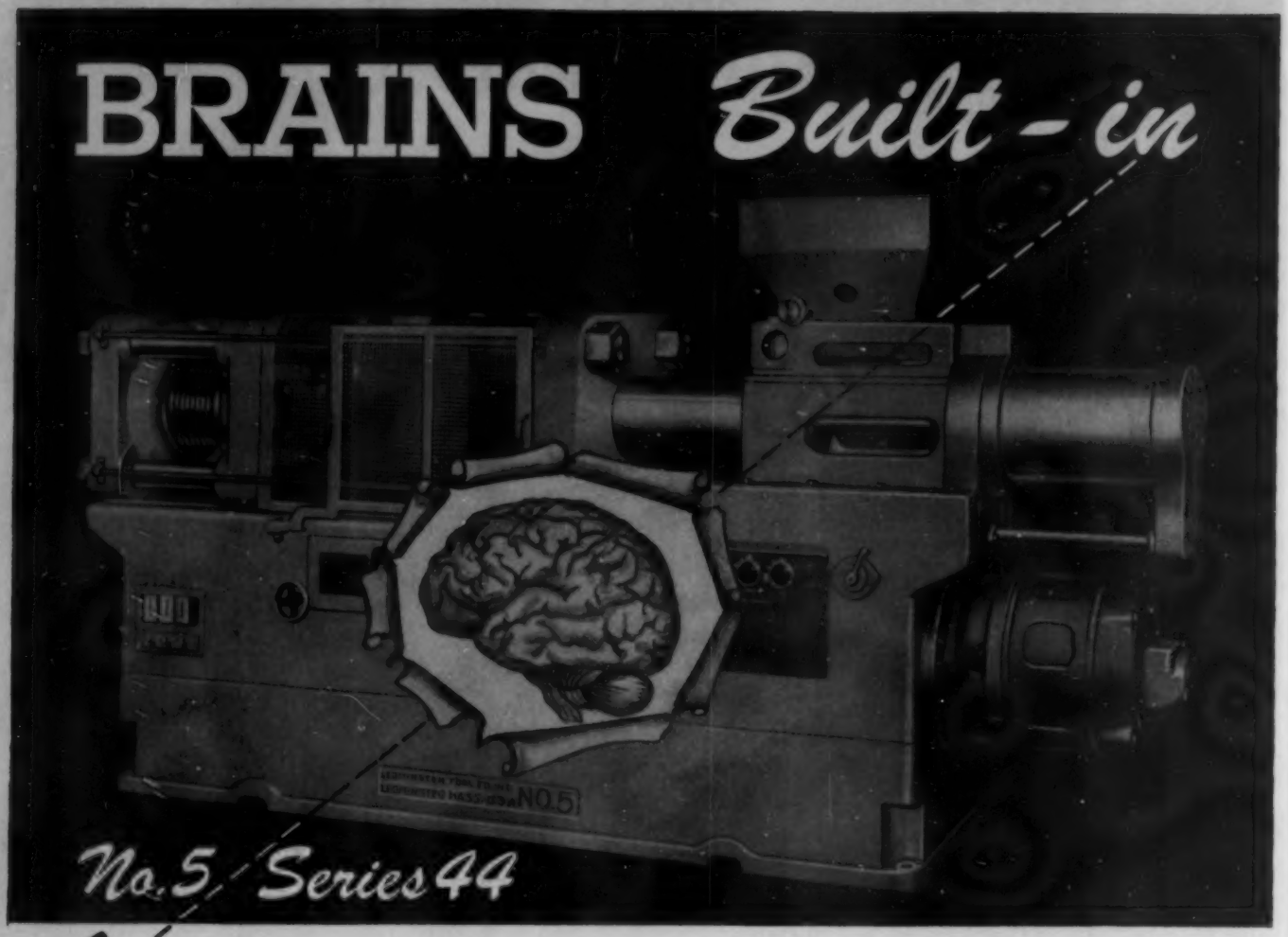
BRAINS *Built-in*



Leominster

INJECTION MOLDING MACHINE

New precision die-alignment, achieved by one adjustment of a single screw, eliminates multiple die adjustment and resultant inaccuracies. This improved adjustment control prevents flooding, reduces rejects to minimum.

"Central-shaft" centralized movable plate support equalizes pressure distribution, and full length pin support in the heavy-duty toggle assembly gets rid of toggle trouble.

Uniform thrust action of the multiple knock-out pin system prevents cramping, breakage and wear of ejection parts.

For Precision Production, Speedy and Safe — Depend on Leominster

2 *Independent* SAFETY *Factors*

Protect The Operator

Machine cannot function while *either* door is open, or when either of the two independent safety controls becomes inactive. Thus utter protection of operator, and "automatic insurance" are effected. Front and back guard doors open individually.

LEOMINSTER TOOL CO., Inc.

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MANUFACTURERS OF MACHINES AND MOLDS FOR THE PLASTICS INDUSTRY

NO ROOM HERE FOR EXPANSION

Watertown moldings have solved a ticklish problem in aircraft starters. The Jack and Heintz aircraft starter, in use on most types of Army and Navy planes is compact, light and exceedingly rugged. It meets today's stringent requirements for starting under extremes of temperature —and there is no room for expansion and no tolerance for contraction of any of its parts. In choosing the five plastics parts molded by Watertown, the manufacturers were able to build an even more rugged starter as these parts maintain fine dimensional stability and the completed unit is lighter and more compact.

Possibly Watertown engineers may help you solve some knotty problem. They can advise you on the use of material and formula to meet your specifications and will gladly offer helpful suggestions on design.

• The Watertown Manufacturing Company, Watertown, Connecticut. *Branch office*—Cleveland. *Sales offices* in New York, Chicago, Detroit, Milwaukee and Hawaii.

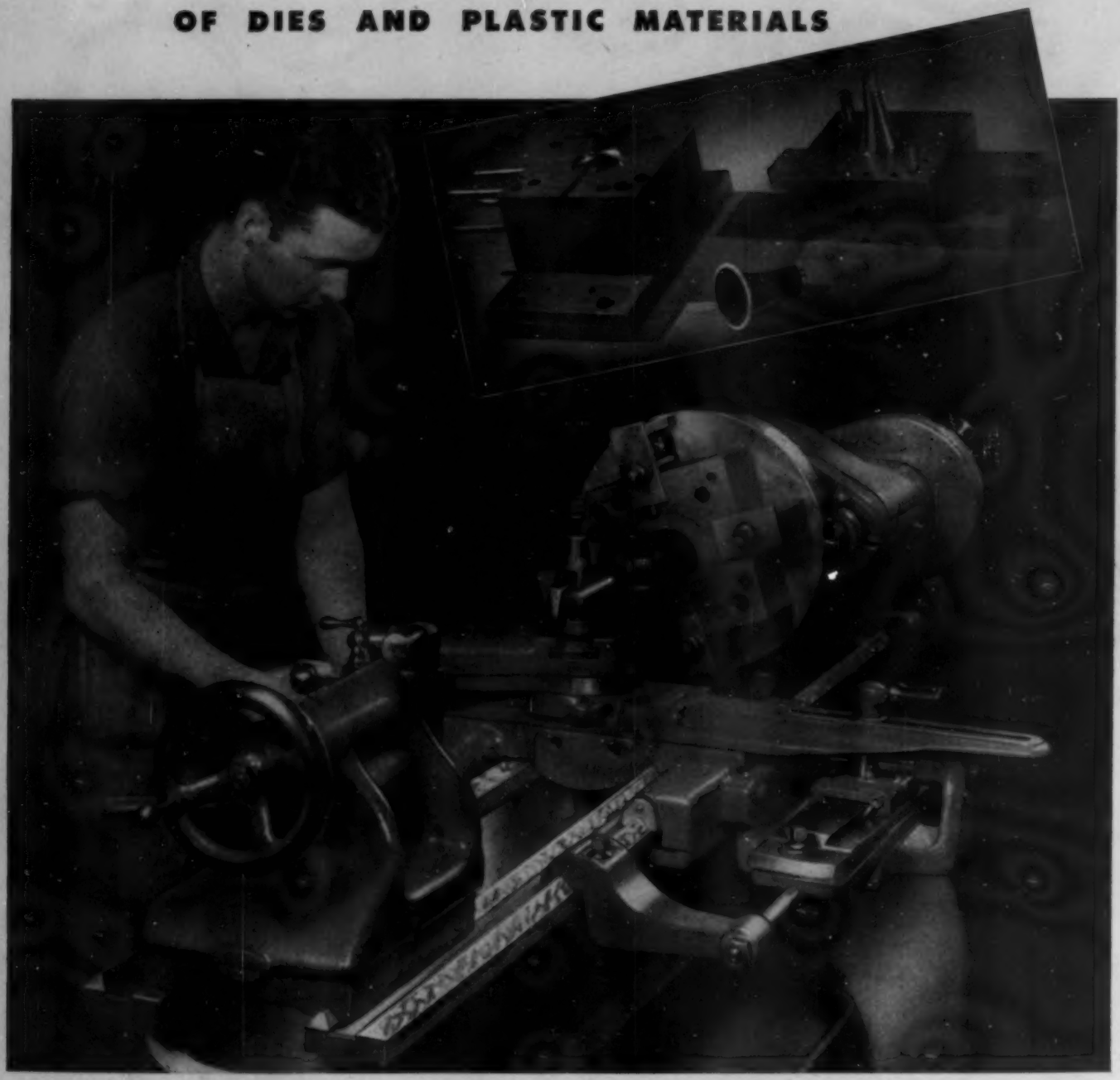
Watertown

A NAME AS OLD AS THE PLASTICS INDUSTRY

DETROIT PUBLIC LIBRARY

SOUTH BEND LATHES

PRACTICAL FOR PRECISION MACHINING OF DIES AND PLASTIC MATERIALS



For the machining of dies where close limits and fine finish are so essential to production efficiency—for many finishing operations on molded parts such as turning, boring, milling and cutting-off—you can depend upon the consistent accuracy and smooth operation of a South Bend Lathe.

Modern in design, South Bend Lathes are best known for their high efficiency in machining work to precision limits. Their wide range of spindle speeds, power feeds for turning and facing operations, plus their smooth power, helps to simplify the most difficult operations on exacting jobs.

Investigate the possibilities of these lathes for handling precision operations in your toolroom, and finishing work in production departments. South Bend Toolroom Lathes and Engine Lathes are made in 5 sizes: 9″, 10″, 13″, 14½″, and 16″ swings respectively. The Precision Turret Lathes are made in two sizes: ½″ and 1″ collet capacity. Write for Catalog No. 100-D showing and describing these lathes.

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ACCURATE FINISHING
One of Many Reasons Why Amos Jobs are Done Right
WHETHER YOU NEED
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OFFICE MACHINES OR INDUSTRIAL EQUIPMENT
Special Handles and Control Knobs for
TOOLS RADIOS AUTOS PLANES
CASES FOR CLOCKS CAMERAS JEWELRY
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Or Anything Else that's a Practical Plastic Application
You Get the Job Done Right by
Amos
MOLDED PLASTICS...
Custom Molders of Parts and Products
INJECTION • COMPRESSION

You see above a section of the Amos finishing department, where molded plastic parts are accurately drilled, assembled and combined with pieces of metal, wood, glass and other materials as specified by the customer. In the insert, you see the new building—about to be completed—to expand Amos facilities for molding and finishing plastics that meet the most exacting customer-requirements.

Accurate finishing is but one of many reasons why Amos jobs are done right. Other reasons include—experienced engineering—the right plastics in the right places—perfect die work—efficient production, with quality control of every operation.

From engineering to finishing, Amos does a complete job—and does it right. Just send us your drawings or write us what you have in mind to be molded in plastics.

AMOS MOLDED PLASTICS • EDINBURGH, INDIANA
Division of Amos Thompson Corporation

OUTPUT RAISER!

It puts a crimp in production to drive screws by hand . . . and then have to file off burrs. But that's what a certain washing machine maker *had* to do as long as he used slotted screws inside his tanks.

COST AMAZER!

But when he changed to Phillips Recessed Head Screws, he eliminated burrs. And no longer having driver skids to worry about, he switched to power driving . . . upped output tremendously . . . and got truly amazing cost-savings.

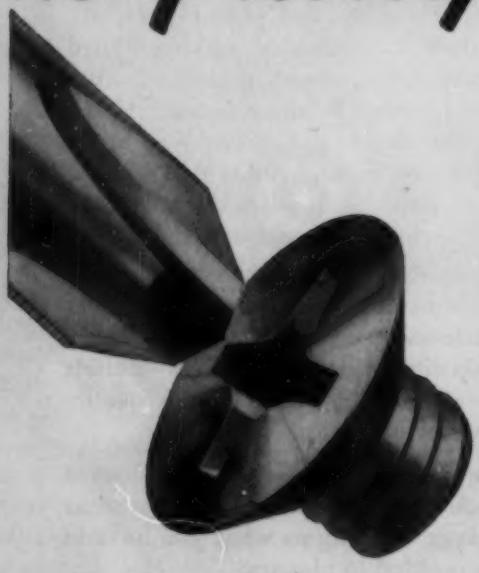
TRAIL BLAZER!

Besides reducing costs and speeding up production, use of Phillips Screws also shows up in product strength and rigidity. Screws with the Phillips Recess help designers plan . . . and get . . . much stronger, tighter fastenings.

COMPETITION FAZER!

Here's the final place where Phillips Screws give you an edge on competition. Any product with these better-looking, burr-free fastenings . . . that never disfigure surfaces or snag clothing . . . is just that much easier to sell!

It's Phillips ... the engineered recess!



In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

. . . It's the exact pitch of the angles that eliminates driver skids.

. . . It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

. . . It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

PHILLIPS Recessed Head SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

24 SOURCES

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The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Wolverine Bolt Co., Detroit, Mich.

"The bigger the family—the better the service"

THAT goes for businesses and families both! Continental has the experience, technique, resources and facilities to give you the service you want.

We make such a variety of containers you can be sure of an impartial analysis of your problem.

Continental now covers every phase of packaging efficiently—metal containers, liquid-tight paper containers and cups, fiber cans and drums, steel pails and other heavy-duty containers.

We're pretty busy serving Uncle Sam now. But keep your eye on Continental! And on Continental's trademark, too. The Triple-C stands for *one* company with *one* policy—to give you only the very best in quality and service.

Tune in: "REPORT TO THE NATION" *every Saturday over coast-to-coast CBS network*

CONTINENTAL CAN COMPANY, INC.

CONTINENTAL PAPER CONTAINER DIVISION

FIBER DRUMS The Container Co., Van Wert, Ohio

LIQUID-TIGHT FOOD CONTAINERS Boothby Fibre Can Co. Roxbury, Mass.

PAPER CUPS Mono Containers, Newark, N. J.

COMBINATION PAPER AND METAL CONTAINERS
Headquarters: 330 W. 42d St., N. Y. C.

13 Plants—Sales offices in all principal cities

Continental has a full line of fiber drums for shipping dry products, resins, rosins, asphalt, grease and other semi-liquids. Sizes range in capacity from 10 to 65 gals.; "Stapak" drums from 2 to 32 gals.; "Fiberpak" drums from ¼ gal. to 67 gals.; Leverpak" drums from 24 to 75 gal. cap. The "Leverpak" drum is illustrated above.

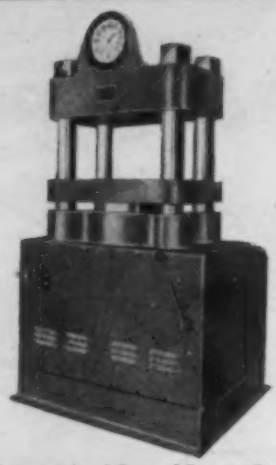
VERSATILE!

IN LABORATORY OR SHOP

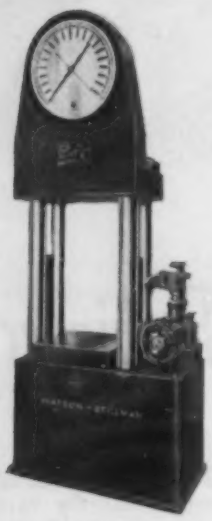
HERE ARE TWO PRESSES that have a wide range of usefulness both in your laboratories and shops. They are ideally suited for performing experiments under conditions approaching actual high production service, as testing machines for concrete testing, compression and bending tests of various materials. They are equally suitable for testing cavity molds, making samples or handling development and research work.

In your shop these presses will also speedily and efficiently handle innumerable actual production tasks such as die work, straightening, metal forming, punching and molding.

Both types are rugged, four-column, self-contained, oil operated hydraulic presses. The power equipment for the General Purpose Type Press is enclosed in a cabinet which forms the base. The power equipment for Laboratory Type Presses is a high pressure hand pump supplemented by air pressure for rapid advance of the ram. Because these presses are of four-column construction, they are far sturdier, more accurate, efficient and easier to maintain in alignment under heavy loads than equally priced presses of two-rod construction. For your press requirements you can choose from a wide range of capacities. Special controls and accessories to fit a variety of applications can be furnished. For complete data and illustrated bulletins write—The Watson-Stillman Co., Roselle, New Jersey.



Compact 4-rod General Purpose Press. Capacity: 20 to 200 tons. Platen range: 8"x 8" to 20"x 20". Double-action ram provides high-speed return to break dies or withdraw punches; convenient hand lever control at front.



This rugged 4-rod Laboratory Press provides pressures on comparatively small areas—10 to 200 ton capacity; platen range: 6"x 6" to 15"x 18"; electric or steam heated platens furnished.

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Designers and Manufacturers of Hydraulic Equipment, Forged Steel Fittings and Valves

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Cruver

SPECIALISTS IN CONVERTING PLASTICS TO WAR
LEADERS IN POST-WAR PLANNING, TOO

Climaxing Cruver's famous wartime achievements, which represent a complete range of plastics and production techniques, we take time out from war to remind you that our experience has enriched our engineering and production knowledge the better to serve you *post-war*.

We are at the service of all industries in planning their custom molding and fabricating.

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AFTER MARS...A RENDEZVOUS WITH VENUS
When Columbia turns from war . . . to peace . . . its creative skill and versatile craftsmanship will play no small part in bringing new glamour and ingenuity to molded plastics of tomorrow. For Columbia Plastics combine unexcelled engineering ability, design sense, scientific research, production technique . . . all made possible by a pioneering organization of vision and unrivalled facilities. In post war days, Columbia will continue to pioneer the road to new perfection in products of molded plastics.
COLUMBIA Plastics
COLUMBIA PROTEKTOSITE CO., INC. CARLSTADT, N.J.

The EYES of AMERICA

are on the Plastics Industry

Seldom has an industry received the unsolicited, spontaneous publicity that has been showered on Plastics. The public's expectations of postwar Plastics are a challenge to the entire industry . . . from raw material producer to manufacturer.

The Plastics field is therefore faced with a double postwar problem:

1. To fulfill those expectations that are practical and capable of fulfillment.

2. To counteract and nullify those that are fantastic and preposterous.

The United States Testing Company, Inc., offers to Plastics concerns a complete Testing program covering the chemical, physical, and electrical properties of Plastics products . . . as well as Tests on their practical application to a specific problem or use. With these Test results, you can adapt your Plastics to postwar civilian uses . . . make necessary changes in manufacture . . . eliminate unwarranted performance claims from your selling and advertising.

Let scientific Testing contribute to your postwar planning. Write for complete price list of Tests, now.

UNITED STATES TESTING CO.

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What FILLER RESULTS do you require?

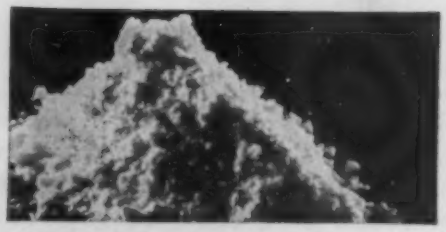
Rayco means **RESULTS!** We go far beyond the supplying of clean, uniform fillers to your specifications. We help you determine those specifications!

While it is comparatively simple to obtain marked improvements by adding a filler, the real problem is to get the MAXIMUM improvement consistent with cost considerations.

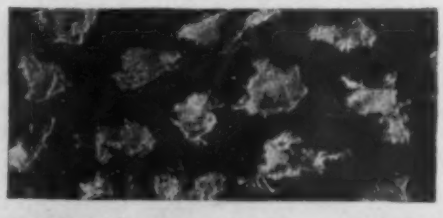
The Rayco approach to your problem is based on wide experience, suitable research facilities, and a lot of "know-how."

Hundreds of modifications of our basic types of fillers have been made to suit specific needs. Whether your desired Filler Result can best be met with an existing cut, or a new one—that is something we work closely with you and your compound manufacturer to determine.

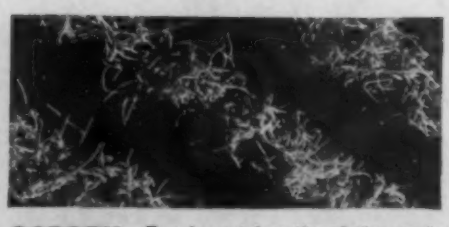
For Filler Results—RAYCO!



FILFLOC Pure cotton flock of surpassing cleanliness and uniformity.



FABRIFIL Macerated cotton fabric for extra strength.



CORDFIL Evenly cut lengths of tire cord; for plastics of utmost strength.

CONSIDER PLASTIC HELMET LINER SCRAP

A number of very interesting applications are being served by this low-cost molding compound of the phenol formaldehyde type. Plenty available. Request sample and price.

RAYON PROCESSING CO. of R.I. INC.

60 TREMONT ST., CENTRAL FALLS, RHODE ISLAND

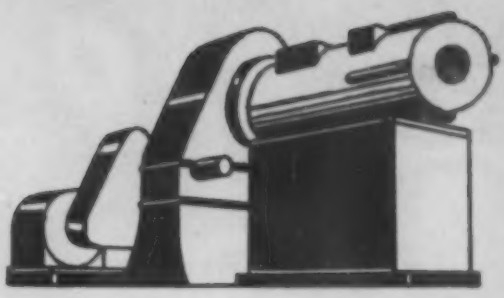
Developers and Producers of Cotton Fillers for Plastics

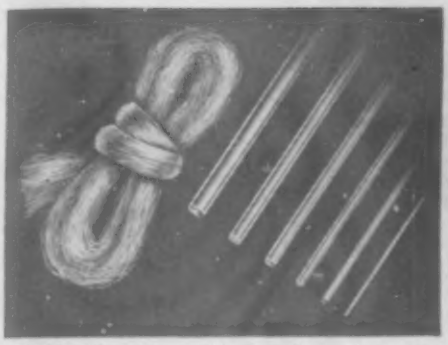
OBTAIN COMPOUNDS CONTAINING RAYCO FILLERS — FOR GOOD FLOW AND EXTRA STRENGTH

TO PUT YOUR

PLASTICS PRODUCTS

"in shape"

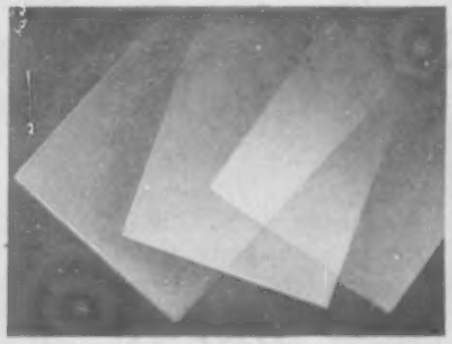




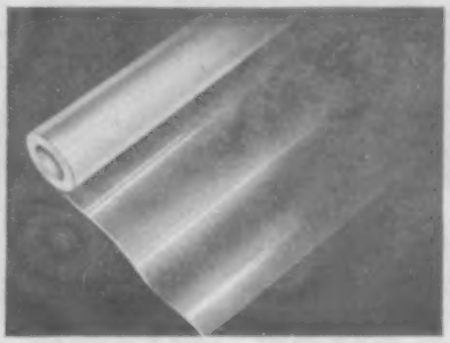
Thin filaments—solid or hollow. Used for wire insulation, fabric weaving.

Tubular extrusions, both rigid and flexible. May be cut to form rings and container sections.

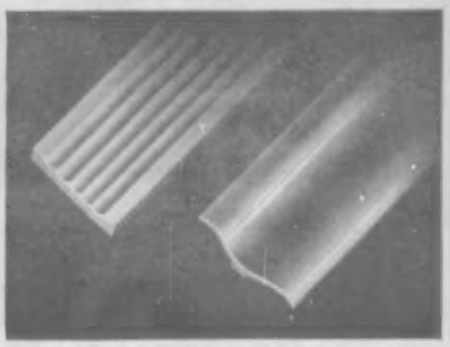
Large tubes, paper-thin, for casings or wrappings for various types of foods, pastes, salves, etc.



Sheets of pliable or rigid crystal-clear, colored, or opaque plastics for a vast variety of uses.



Transparent film for a host of wrapping and moisture-proof packaging jobs.



Special shapes for every requirement. May be stamped or punched after extrusion.

YOU can form plastics into practically any continuous shape you want by the use of plastics extrusion machinery. And the *big* advantage of this method of plastics production is its *simplicity, economy* and *ease* of operation.

Note, for instance, the shapes pictured above. Thin, thick, flexible, or rigid . . . solid or tubular . . . these plastics sections were all produced by the continuous extrusion process. Stamping or cutting after extrusion adds another infinity of possibilities for plastics parts production. No wonder that hundreds of manufacturers in every type of industry planning for postwar product development have asked us for further information on plastics extrusion machinery.

Look at the typical shapes above. Remember that you can extrude plastics into practically any desired shape. Then, *think* of *your* product in terms of this money saving, simplified production method, and write for further information to National Rubber Machinery Company, Akron 11, Ohio.

NATIONAL RUBBER MACHINERY CO.

General Offices: Akron 11, O.

Plastics

MACHINERY DIVISION

THIS POWDER COMPACT MIGHT NOT APPEAL TO THE LADIES:

Official U. S. Navy Photo

BUT—TO A **ROCKET** IT'S THE *LAST* WORD!

With the U. S. Navy's permission, we illustrate the Igniter for rocket firing. The body of this two-piece part was Sterling-molded from clear cellulose acetate. It is designed to contain, compress and seal-in a prescribed amount of explosive powder.

The compression is effected by screwing the threaded cover down into the threaded body; the thread travel allowing for a countersunk fit!

When filled and closed, an application of cement seals the threads, forms the two pieces into an integral unit and readies it as a component part of the rocket assembly.

Unique features incorporated in the construction of the four cavity die automatically molds-in the outside threads of the cover as well as the inside threads of the body . . . thus eliminating fabrication and special finishing.

It is certain that the rigorously precise manufacturing technique developed for this part will stand Sterling in good stead as soon as postwar planning enables us to again plunge into peace-time plastics problems. In the meantime, we welcome the opportunity to think out ideas with you. Inquiries invited!

STERLING PLASTICS CO., 1140 COMMERCE AVE. UNION, N. J.

PANELYTE*

is a service . . .

As Well As A Complete Line Of Thermosetting Plastics!

PANELYTE is more than a trade-name for a wide range of structural laminated resinous plastics. The mass-production of sheets, rods, tubes, molded forms and fabricated parts — research and engineering accomplishments . . . plus accumulated application knowledge—adds further significance to the name. The sum-total is expressed in PANELYTE Service . . . from coast-to-coast!

Come to PANELYTE for reliable, up-to-the-minute information on the use of thermosetting plastics. Ask us *if* and *how* laminated plastics can be employed to produce better structural and insulating parts for you — in less time — and at lower cost. PANELYTE engineers, familiar with properties, advantages *and* limitations, can recommend the specific grade best suited to a given application. Their design advice can prevent costly errors. Efficient, straight-line production assures adherence to specifications and prompt deliveries.

Avail yourself of PANELYTE Service by giving us detailed information on the design and use of the part in question.

Write for factual Data Book!

PANELYTE *the structural plastic*

PANELYTE DIVISION
ST. REGIS PAPER COMPANY
230 PARK AVENUE
NEW YORK 17, N. Y.

Sales Offices: Atlanta, Boston, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Kansas City, Los Angeles, Mexico City, Montreal, New Orleans, Phoenix, St. Louis, St. Paul, San Francisco, Seattle, Syracuse, Toronto, Trenton, Vancouver

*MASS PRODUCTION OF SHEETS, RODS, TUBES, MOLDED FORMS, FABRICATED PARTS IN PAPER, FABRIC, FIBRE GLASS, WOOD VENEER AND ASBESTOS BASE LAMINATES

WANT ANY HOT PLASTICS?

Take it any way you like—we don't sell 'em.

We don't like "hot" applications. We prefer to test coldly, scientifically, any use of plastics materials. That means at every stage of production—design, tooling, molding, finishing. We like to know which material is best. We like to see that the mold is built right. And we watch the piece right through production until it gets into your hands.

We don't sell overheated plastics either, if we can help it. We try to establish controls that give just the right amount of cure—not too much, not too little. So your finished part is neither too well done nor underdone.

If you don't like to use mirrors or magnifying glasses to get the low-down on plastics, you need a copy of our free cook, "A Ready Reference For Plastics." Free, that is, to business men and Government employees who write for it on their own letterheads.

And we definitely do not deal in the kind of hot plastics that mean bending the spirit of Allocations away from its intention. We have been allout for war long enough for our employees to win three Stars on their "E" flag. We know that the war is going to end some day and we are doing our utmost to hasten that day by giving war production top priority right down the line. Our customers seem to understand and appreciate this since they are doing the same themselves.

When this thing is over, we will, of course, be at the service of all with a slightly enriched experience and enlarged plant.
See us now or then. We will be glad to know you.

BMCD

ARMY E NAVY

BOONTON MOLDING COMPANY

MOLDERS OF PLASTICS · PHENOLICS · UREAS · THERMO-PLASTICS

BOONTON · NEW JERSEY · Tel. Boonton 8-2020

NEW YORK OFFICE

Chanin Bldg., 122 East 42nd Street, New York 17, N. Y., MUrray Hill 6-8540

Plexiglas demonstration models are effective aids to selling. Models like the Nelson Stud Welder, which permit an "inside" view of working parts in operation, are worth more than many words of "sales talk".

How to Clarify Selling Points with Plexiglas

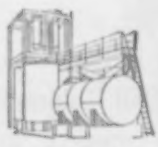
IN the highly competitive post-war market, you'll find transparent PLEXIGLAS a real boon to selling efforts. This light-weight, crystal-clear plastic that is both shatterproof and highly resistant to chemicals is ideally suited to demonstration models... permitting an unobstructed view of construction details or mechanical operations.

Reproductions of parts or products in PLEXIGLAS serve a multiple purpose: they provide a quick, visual means of instructing sales personnel . . . add new interest to the sales story...give servicemen a sound working knowledge for maintenance and repair.

Would transparent replicas of your products—or parts of them—help clarify *your* selling points? Then why not consult us about the most effective use of PLEXIGLAS? Call our nearest office: Philadelphia, New York, Detroit, Chicago, Los Angeles, Cleveland. Canadian Distributor: Hobbs Glass Ltd., Montreal.

Only Rohm & Haas makes PLEXIGLAS

PLEXIGLAS IS JUST ONE of the many types of products developed by Rohm & Haas research. The varied fields this company serves with a diversified line of chemicals range from aircraft (plastics) to agriculture (insecticides and fungicides), textiles (reducing agents and fabric finishes), enamelware (porcelain opacifiers), and leather (synthetic tanning materials and finishes).



PLEXIGLAS is the trade-mark, Reg. U. S. Pat. Off., for the acrylic resin thermoplastic sheets and molding powders manufactured by Rohm & Haas Company.
Represented by Cia. Rohm y Haas, S.R.L., Carlos Pellegrini 331, Buenos Aires, Argentina, and agents in principal South American cities.

"Looking Ahead . . . *through Plexiglas"*

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Manufacturers of Chemicals including Plastics . . . Synthetic Insecticides . . . Fungicides . . . Enzymes . . . Chemicals for the Leather, Textile and other Industries

A MODERN SYLLOGISM

MAJOR PREMISE:

Bell Telephone System serves the American Public.

MINOR PREMISE:

Bell Telephone Laboratories develop the facilities of the Bell System.

CONCLUSION:

Therefore, Bell Laboratories serve the American Public.

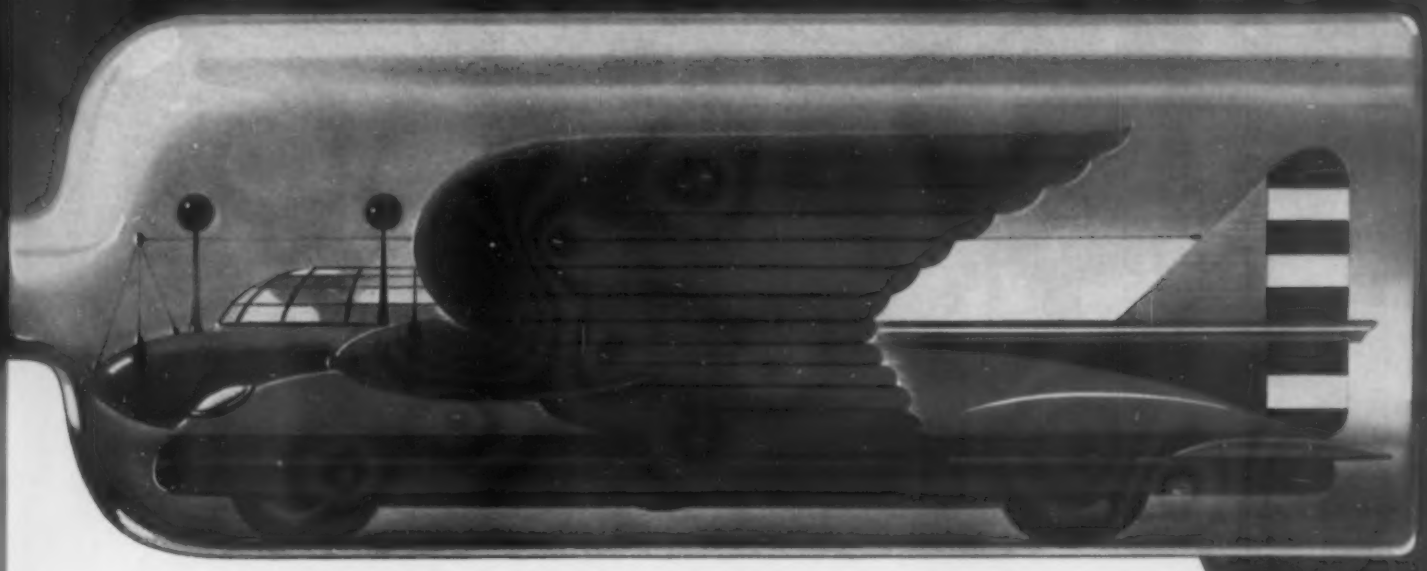
And that is the *raison d'être* of the Laboratories. For the Bell Telephone System, the Laboratories carry on research studies in all the sciences and development work in all the engineering arts that relate to electrical communication.

For the Western Electric Company, the manufacturing unit of the System, the Laboratories develop equipment, prepare specifications for its construction, and engage in various engineering activities.

For the Armed Forces of the United States, under contracts of the Western Electric, the Laboratories have undertaken more than a thousand development projects — many with spectacular effect upon our enemies.

BELL TELEPHONE LABORATORIES ***explore and invent, devise and perfect for our Armed Forces at war and for continued improvements and economies in telephone service.***

VERY PRETTY.. *But what is it?*



That super-streamlined object is a plastic something or other someone has envisioned to blossom forth in the post-war world. It is typical of what so many expect of our brave new world . . . spanning perhaps half-a-century of technological progress in a few weeks.

These starry-eyed plans for the day after tomorrow are fine. Our Mills engineers have done some dreaming themselves . . . but they've done it at their drawing boards with all the latest developments in thermoplastics at their finger tips.

Naturally they look toward the future but their planning is grounded in day-to-day progress. Their knowledge of the increasing possibilities as well as limitations of injection molding and extrusion processes is ever growing. They will gladly help you in determining your peacetime production plans.

Write on your letterhead for the new Injection Molded and Extruded Plastics catalog. Or, for detailed information about MILLS-PLASTIC * pipe, tubing and fittings, write for circulars containing data and illustrations. * Trade mark reg.

ELMER E. MILLS CORPORATION

Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Crystallite, Polystyrene, Styron, Lustron, Loalin, Vinylite, Mills-Plastic, Saran and Other Thermoplastic Materials

153 WEST HURON STREET, CHICAGO 10, ILLINOIS

They Want To Know What Thermatron

ELECTRONIC HIGH FREQUENCY HEATERS CAN DO FOR THEM

"We are interested in doing some experimental work with high frequency for heating pre-form laminated sheets."

"We are manufacturers of paper bag and converting machinery and are interested in the Heaters as applied to laminating and heat sealing paper in the production of paper bags."

"We manufacturers of labels coated with a hot melt adhesive, we have the problem of applying the hot melt adhesive to the paper web."

"We are interested in the application of heating and drying tobacco, particulary as to the drying in hogsheads."

"We are interested in your Thermatron electronic high frequency heating system for the drying of sole leather."

"Could it be used to partially dry ordinary building brick previous to burning them in the kiln?"

"We are interested from a viewpoint of drying textiles after they come from our wet processing."

The Answer IS THAT APPLICATIONS FOR Thermatron INTERNAL HEAT GENERATION ARE SO VAST THAT WE HAVE NOT AS YET EVEN TAPPED THE SURFACE.

Thermatron —heat without flame—can be extensively used in the setting of plastics. It heats and dries all types of non-metallic materials, including textiles, paper, powders, wools, ceramics, etc. It cures rubber and sets glues.

SUBMIT SAMPLES of your materials, along with details of your problem, to Radio Receptor engineers. We will be glad to make all necessary tests, and give you a full, unbiased and confidential report, including our opinion as to whether or not it will pay you to use this type of heat. There is no charge or obligation for this service.

Write, on your own letterhead, for our new **Thermatron** *folder to Dept. M-3*

Standard sizes from 500 watts to 30 kilowatts output.
Units of special sizes and frequencies built to order.

Thermatron Division

RADIO RECEPTOR COMPANY, Inc.

251 WEST 19th STREET NEW YORK 11, N.Y.

SINCE 1922 IN RADIO AND ELECTRONICS

Go fancy-free on color with Unsoilable VELON

Now take the word "impractical" out of your color vocabulary forever! Any color effect, anywhere, is *practical* with *Velon*.

Just imagine a material so versatile that you can use it in the upholstery of plane, train and bus seats—and at the same time in the most luxurious living room suites—in the lightest pastel shades or the deepest jewel-tones of rich color, and in an infinite variety of weaves in interesting textures and patterns.

For all these you can use the same brilliant tones, the same gay patterns as in women's handbags, shoes, belts and hats. Because they, too, can be beautifully made of *Velon*.

In any form, *Velon* can take any abuse and come up smiling after a mere wipe with a damp cloth or cleaning fluid. After years of the hardest kind of use in hundreds of public vehicles, *Velon* still shows no sign of wear, has lost none of its original colorful beauty!

Velon won't absorb moisture, won't let dirt cling, gives grease no foothold. It resists alkalis, acids, solvents. It is stainless, non-fading, and it is also non-inflammable.

Give your inventiveness free-rein! In any product where you want both color and extreme durability in fabric, screening or film, *Velon* is the answer.

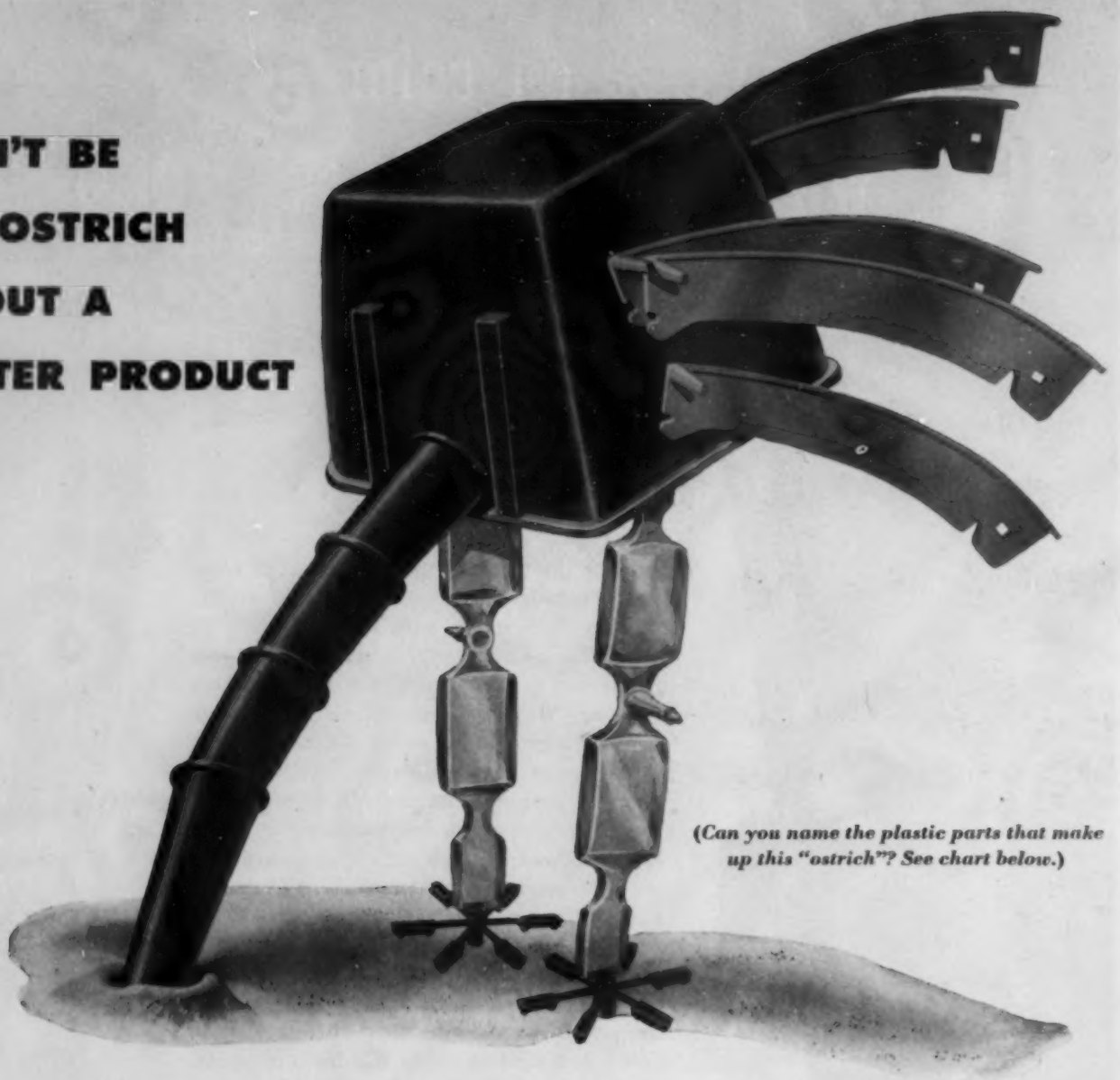
At the moment, all the *Velon* Firestone can make goes to the armed forces. But you can start now to include *Velon* in your postwar plans.

LISTEN TO THE VOICE OF FIRESTONE MONDAY EVENINGS OVER NBC

ANOTHER CONTRIBUTION TO A BETTER WAY OF LIFE *by* **Firestone**

*Trademark—Pronounced VEL-LON

DON'T BE AN OSTRICH ABOUT A BETTER PRODUCT



(Can you name the plastic parts that make up this "ostrich"? See chart below.)

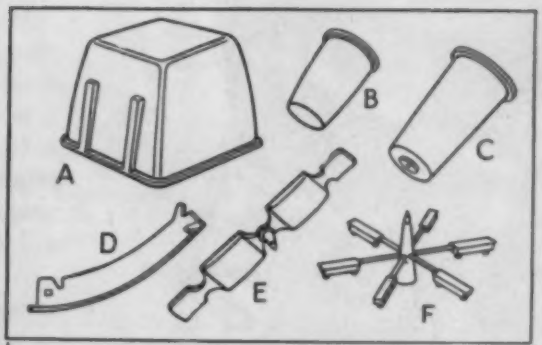
If you're buried in plans for improving your present product or hatching a new one, Continental's Plastics Division can bring you out of the dark.

Whatever features your product requires—beauty, durability, lightness, toughness, or anything else—you can depend on our engineers, designers and research men to do the job right. Their years of experience and close contact with the foremost manufacturers of raw materials guarantee you the best service possible.

Our Plastics Division is equipped to fabricate a wide range of products in the most efficient and economical way—by compression, injection, extrusion, lamination or sheet forming.

So count on Continental for the latest and best in plastic products. You'll find an alert, progressive organization giving sound, practical advice and assistance at all times.

Tune in "REPORT TO THE NATION," every Saturday over CBS coast-to-coast network.



(a) Film development tank—compression; (b) Outside shell for vaporizer—compression; (c) Sales ticket holder—compression; (d) Segment for circular file—injection; (e) Hairbrush handles—injection; (f) Drawer pulls—injection.

CONTINENTAL CAN COMPANY, INC.

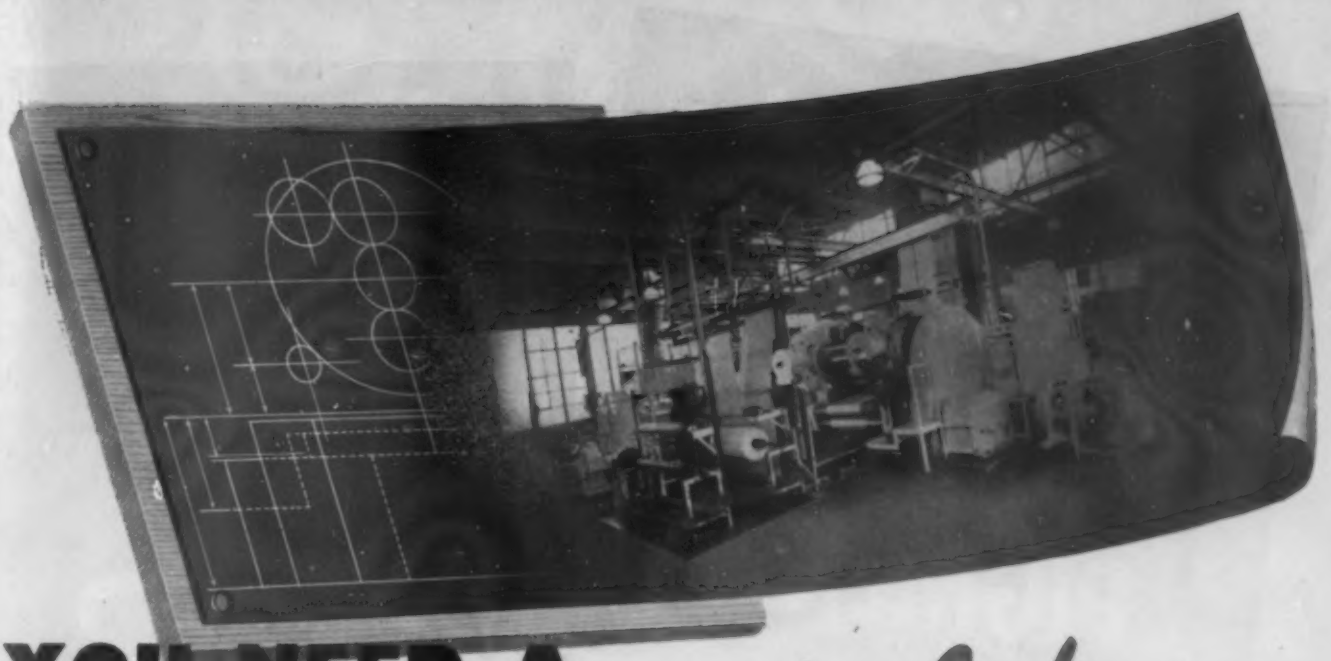
PLASTICS DIVISION

HEADQUARTERS: Cambridge, Ohio

Sales Representatives in all Principal Cities

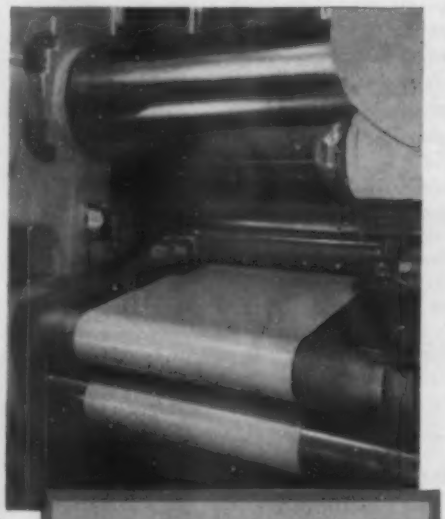
COMPRESSION • INJECTION • EXTRUSION
SHEET FORMING • LAMINATION

Other products of Continental Can Company: Metal cans for food and other products; fibre and paper containers; crown caps and cork products; machinery and equipment; special war cans and weapons.



YOU NEED A *Designed-for-the-Job* CALENDER

to apply vinyl resin at 300°



Here is a Farrel-Birmingham calender at the plant of the Textileather Corporation of Toledo, Ohio. It is applying a smooth, even coat of thermoplastic vinyl resin to a fabric backing at a temperature exceeding 300°F. *Designed-for-the-job,* this calender gives consistently efficient service despite the high operating temperature.

To assure maintenance of the required temperature, the rolls are chamber-bored for circulation of high-pressure steam. They are carried in full bronze-lined journal boxes which are adequately protected against the heat of the rolls by a continuous circulating system of flood lubrication. The machine is of heavy construction throughout to provide the strength and rigidity essential for accuracy and uniformity.

The top and bottom rolls have motor-driven adjustments, while the side roll adjustment is hand operated. Continuous tooth herringbone gears — the well known *Gear with a Backbone* — are used throughout. They are fully enclosed, and run in an oil bath.

This is one example of the calenders Farrel-Birmingham builds to meet specific plastic processing problems. They are available in sizes from 8" x 16" to 32" x 74", with any number and arrangement of rolls and whatever special attachments the job calls for.

Write for further information on calenders or any of the other types of equipment listed on this page.

F-B Plastics Machinery

- Banbury Internal Mixers
- Roll Mills
- Converting, Mixing and Sheeting Rolls
- Calenders
- Extruding Machines
- Hydraulic Presses
- Hydraulic Accumulators
- Sheet Cutters or Planers

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.

Sales Offices: Ansonia, Buffalo, New York, Pittsburgh, Akron, Los Angeles

Farrel-Birmingham

What Plastics to Use with LUMINESCENT PIGMENTS

To obtain optimum luminescence, water-clear plastics should be used with luminescent pigments. *Thermoplastics* such as methyl methacrylate, polystyrene, cellulose acetate and vinyl acetate-chloride copolymers may be used with either the fluorescent or the phosphorescent types of luminescent pigments. Fluorescent pigments and the zinc and cadmium sulfide types of phosphorescent pigments may be used with *thermosetting* materials such as clear phenolics, ureas and melamine plastics. The calcium and strontium sulfide types of phosphorescent pigments, however, are apt to be reactive with the thermosetting plastics. The latter pigments, of course, can be used with thermoplastic resins.

THESE COLORFUL, "GLOWING" PIGMENTS WILL BROADEN THE MARKET FOR PLASTICS by introducing useful color to conditions of darkness or semi-darkness in applications such as:

FLUORESCENT:
(Excited by "black" light exposure)

- Automotive and aviation dials and accessories
- Decorative effects
- Displays and advertising
- Light diffusers and color transmuters
- Radio dials and decoration
- Theatrical effects

PHOSPHORESCENT:
(Excited by daylight exposure)

- Apparel accessories
- Architectural trim
- Automotive accessories
- Cord pulls (lights and window shades)
- Decorative effects
- Displays and fixtures
- Door knobs and kick plates
- Electric switch plates, fixtures and equipment
- Escutcheons and medallions
- Flashlights
- Fish lures
- Games
- Household items
- Jewelry
- "Juke" boxes
- Light diffusers
- Marking tapes
- Product packages and labels
- Slipper tips
- Tools

We shall be glad to discuss with you the incorporation of luminescent pigments in your plastics, including such information as when to incorporate the pigment, what care, if any, is required during processing, how much pigment to use, what other coloring materials may be used, and what care is required in molding of luminescent plastics.

MOLDERS
LAMINATORS
FABRICATORS

If your present material supply house cannot furnish you with luminescent granules or sheets, we shall be glad to supply the names of producers of plastic molding compounds and sheets.

New Jersey Zinc

THE NEW JERSEY ZINC COMPANY

160 FRONT STREET • NEW YORK 7, N. Y.

Products Distributed by THE NEW JERSEY ZINC SALES COMPANY

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PLIOBOND

QUICK-SETTING ADHESIVE

"Bonds anything to anything!"

Pliobond is a new Goodyear synthetic development that creates a lasting, high strength, vibration-proof union between many diverse materials—woods, metals, plastics, fabrics, unglazed ceramics, rubber, paper, leather, plaster, concrete, etc. It has seven outstanding features:

1. EASE OF APPLICATION—brushing, spraying or spreading.
2. RAPID DRYING—2 to 5 minutes if desired.
3. QUICK SETTING—24 hours maximum at room temperature with highly porous materials; much faster with heat or pressure.
4. HIGH BOND STRENGTH—up to 1,500 pounds per square inch.
5. RESISTANT—to water, chemicals and solvents.
6. FLEXIBILITY—bonded materials can be flexed, bent or sheared without impairing permanency.
7. LONG DURABILITY—bond doesn't harden or brittle with age. Doesn't loosen from vibration.

For sample and complete technical information concerning Pliobonding of any types of materials, write: Goodyear, Plastics and Chemicals Division, Akron 16, Ohio.

Pliobond—T.M. The Goodyear Tire & Rubber Company

FLEXIBILITY *PLUS*—(A) Marble finish plastic Pliobonded to metal sheet. (B) Such combination sheets can be bent, formed or sheared without damaging bond.

A PRODUCT OF GOODYEAR RESEARCH

GOODYEAR

THE GREATEST NAME IN RUBBER

CASE HISTORIES PROVING THE POWER OF THE PRESS

LAKE ERIE IS READY FOR THE PLASTICS AGE

LAKE ERIE self-contained, semi-automatic hydraulic presses offer many new developments for all types of plastic molding.

Illustrated are two of these latest presses of sixty tons capacity; 18″ x 16″ platens; 12″ stroke. These units have complete time cycle and full automatic push-button control, including adjustable plasticizing and breathing stroke.

Lake Erie is ready for the "plastics age". We can adapt standard presses to your compression molding needs or build special presses to your specific requirements. Write for information.

LAKE ERIE
ENGINEERING CORP.
BUFFALO, N.Y. U.S.A.

LAKE ERIE ENGINEERING CORPORATION
868 Kenmore Station, Buffalo 17, N. Y., *Offices in Principal Cities*

A WARRIOR BECOMES A WORKER!

Recently, demands of the war program have rapidly changed and we, at Northwest Plastics, have found it imperative that new manufacturing processes be developed, and new production methods speedily increased. Today, through modern research and able management, these objectives are being achieved. Here, we are working day and night producing vital plastic parts for essential war industry.

We invite inquiries from concerns requiring assistance with their plastics problems. The finest of engineering skill and the most modern equipment are at your service. Write today for information. Northwest Plastics, Inc., 2233 University Avenue, St. Paul 4, Minnesota.

ARMY ORDNANCE AWARD

FOR MERITORIOUS PRODUCTION

Compression moulding • Transfer moulding • Injection moulding • Extrusion moulding
Modern Tool and Die Department • Finishing, Fabricating and Assembling Department
Laboratory for Development and Production Control • Engineering and Product Design

SOCIETY OF THE PLASTICS INDUSTRY

NORTHWEST PLASTICS inc.

SANTAY wanted to bring the camera into focus, but the Armed Services said, "Censored"! However, here's another example of Santay's ability to make intricate PLASTIC and METAL ASSEMBLIES.

Santay possesses the four important factors in producing intricate PLASTIC and METAL ASSEMBLIES; (1) design ability, (2) development ingenuity, (3) manufacturing facilities, and (4) the desire to serve. In addition, Santay possesses that all important factor: the art of making molds, which is fortified by twenty-five years experience in designing and making tools.

Santay continues to produce intricate PLASTIC and METAL ASSEMBLIES now, as they will in times of peace. Should you be planning to have a PLASTIC or METAL ASSEMBLY produced, may we suggest you investigate this skilled precision craftsmanship!

Santay
SYMBOL OF PRECISION CRAFTSMANSHIP

INJECTION MOLDING • METAL STAMPING • ELECTRO-MECHANICAL ASSEMBLIES

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DEEP COMPRESSION MOLDING with MEGATHERM* Electronic Heat

They said it couldn't be done — but the Kuhn & Jacob Molding & Tool Company of Trenton, New Jersey did it . . . *with Megatherm!*

All previous attempts to compression-mold this heater-coupling with ordinary methods of preform heating, had resulted in rejection ratios as high as 99 to 1. Because of its large size, irregular shape, and variable thickness, it posed a difficult production problem.

But the high-speed uniform heating of the rag-filled resin-bonded preform with Megatherm electronic heat resulted in flawless finished couplings with a smooth surface and minimum flash that passed rigid inspection tests 100%.

Here is another proof that Megatherm can do the job better . . . not only in production problems involving large parts, irregular shapes, and variable thicknesses, but in run-of-the-mill operations.

And as a result, more and more plastic processors are installing Megatherm . . . the modern tool for modern industry. Get the story on Megatherm now.

Federal Telephone and Radio Corporation

*Reg. U. S. Pat. Office

INDUSTRIAL ELECTRONICS DIVISION

An IT&T Associate

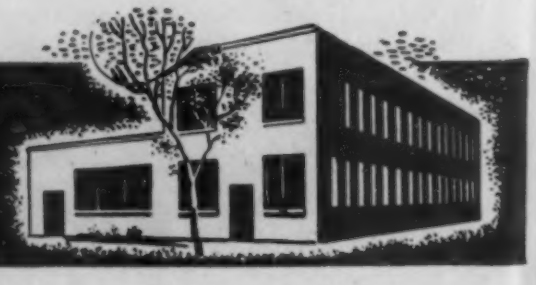
Newark 1, N. J.

IN SIZES UP TO 9½" x 14½"

Shown above are the hob and a cavity for a telephone base—the block for the cavity measures 7" wide by 10" long. But Midland equipment and skill make use of still larger blocks—up to 9½"x14½".

Whatever your requirements for hobbed cavities of molds for plastic and die cast parts—small, large, deep, intricate, multiple—call on Midland, where equipment, experience and skill will result in precision far beyond your expectations.

The story of "Hobbed Cavities by Midland" is told in our book "Shaping Tomorrow Today." Your copy is ready. Write for it today!



MIDLAND DIE
AND ENGRAVING COMPANY
1800 W. Berenice Avenue • Chicago 13, Illinois

BAKELITE

TRADE-MARK

The Plastic with the "TWO-WAY S-T-R-E-T-C-H"

INTO THE MOLD goes a charge of die-cut cloth. Several minutes later, out comes a fully formed aircraft antenna mast, clean of line and sleek of finish. The seeming miracle takes place because this is no ordinary cloth. It's a fabric impregnated with BAKELITE phenolic resin. It is called Resin X-Crepe molding material, made by Cincinnati Industries, Inc.

An outstanding feature of Resin X-Crepe molding material is its "two-way stretch"—its extraordinary ability to extend itself under pressure without ripping or tearing in the mold. This permits the formation of curved parts and deep-drawn moldings of great mechanical strength—gives ends, domes, corners, and other sections that essential extra toughness. The material can also be used with other BAKELITE molding plastics to provide reinforcement at vital points.

Products molded of Resin X-Crepe have high impact strength. They're resistant to heat, cold, moisture, and chemicals. Their dimensional stability meets the exacting needs of a wide range of applications. Electrical properties approximate those of most phenolic plastics.

Resin X-Crepe materials offer manufacturers and designers extensive possibilities for product improvement. Write Department 15 for further information.

TRADE MARK

BAKELITE CORPORATION

Unit of Union Carbide and Carbon Corporation

UCC

30 EAST 42ND ST., NEW YORK 17, N. Y.

Molding Plastics

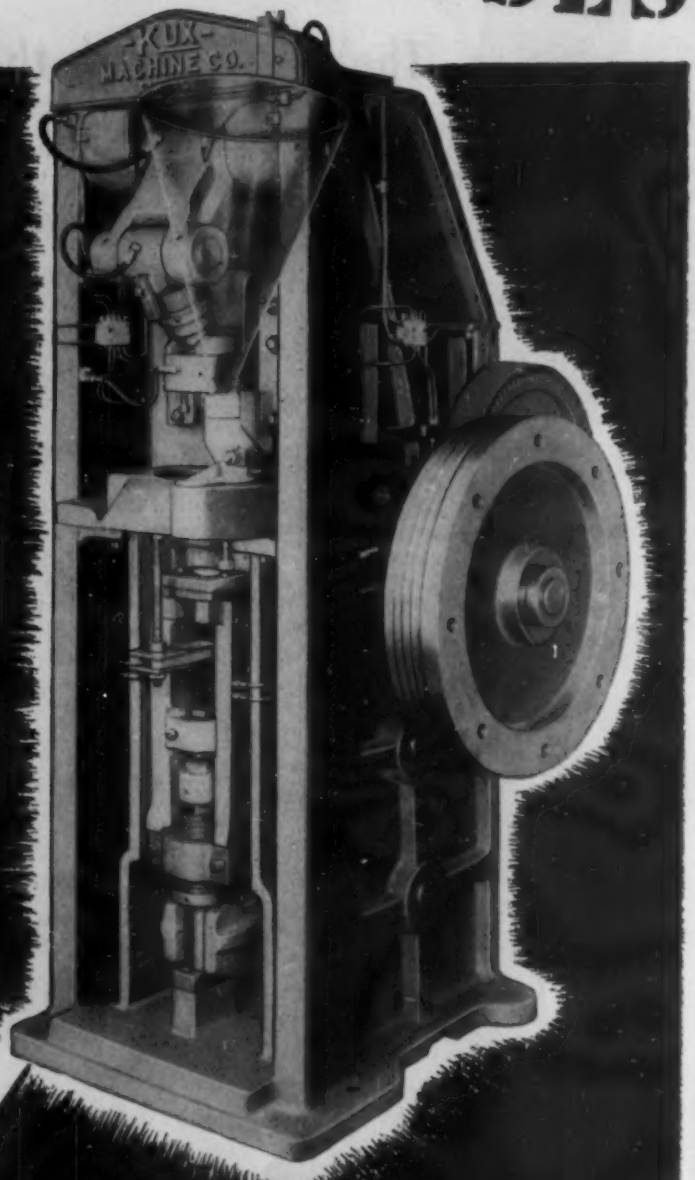
STURDY

KUX PREFORM PRESSES

The new massive Model 65 produces preforms 3" diameter, has a 3" die fill and applies 75 tons pressure

This rugged preform press with its heavy duty, one-piece cast steel main frame will produce odd shapes as well as round preforms. The pressure applied by both top and bottom punches results in more solid, dense preforms, which have less tendency to crumble or break during handling. This new Model 65 press is built to safely withstand high pressures of up to 75 tons at top production efficiency.

Choice of a complete size range of machines in both single punch models and multiple punch rotaries is also available.



WRITE DEPT. P FOR NEW CATALOG OR DEMONSTRATION

KUX MACHINE COMPANY

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COST-SAVING METHODS . . .

IMPROVED PRODUCTS?

*Allymer 170

may hold your answer

in the plastics field

Allymer 170 possesses especially desirable qualities for impregnated and laminated products. For example,

Rapid Curing—Allymer 170 has been developed expressly for reducing curing time and speeding up production.

Simplified Tooling—Allymer 170 is used with contact or very low pressures. Equipment required is relatively simple and inexpensive—particularly important with short-run items.

Larger Sections—Allymer 170 confers great strengths on laminates. Larger parts may be made—replacing two or more sections, thus reducing assembly costs.

These are but a few of the features which combine to make Allymer 170 unique in the plastics field. Your investigation of its adaptability to your products may bring important improvements to your operations.

* **SEND FOR DATA ON THIS NEW MONOMER**

Allymer 170 is a viscous liquid of low volatility which solidifies into a hard, insoluble, infusible solid when heated in the presence of a catalyst. It has practically no odor at room temperature, is non-irritating to the skin, evolves no gaseous or other by-products during polymerization.

Additional data is available on request—samples may also be obtained for experimental purposes.

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PITTSBURGH PLATE GLASS COMPANY
COLUMBIA CHEMICAL DIVISION
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Get flexible lighting

for each employee . . . each job . . .

with DAZOR *Floating* LAMPS

MORE PRODUCTION

Both machine and hand operations go faster, more smoothly, with controlled localized lighting. Dazor *Floating* Lamps help employees improve and maintain efficiency.

HIGHER ACCURACY

Adequate lighting aids precision, reduces errors, conserves materials by cutting down spoilage. Dazor high intensity illumination is just right for inspection tasks.

GREATER SAFETY

By lighting dark areas and danger points, eliminating reflected glare, reducing eyestrain and fatigue, Dazor *Floating* Lamps help to check accidents at the source.

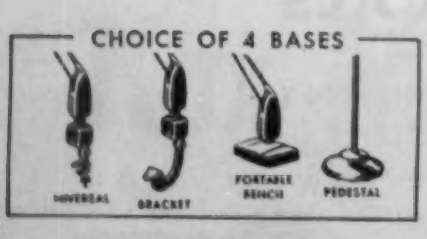
LOWER COSTS

Dazor *Floating* Lamps deliver productive, economical light. Option of fluorescent or incandescent lamps and 4 base types provides a correct fit for each installation.

Employees differ . . . and jobs differ . . . in their lighting needs. That, in a nutshell, is the reason for the Dazor *Floating* Lamp—the first lamp with complete lighting *flexibility* at the point of work. The operator's finger-tip touch *floats* the Dazor Lamp to the exact position desired, where it *stays put* without fastening. An enclosed balancing mechanism holds the lamp arm at the place chosen . . . firmly . . . automatically.

At the left are typical advantages of Dazor illumination on machine tools, assembly lines, inspection benches and drafting boards. To gauge these economies fully, get details from your experienced and cooperative Dazor-appointed distributor. If you'd like this 16-page descriptive booklet, ask for Booklet "P"; we'll send it promptly. Dazor Manufacturing Co., 4467 Duncan Ave., St. Louis 10, Mo.

CHOICE OF 4 BASES



Call your electrical wholesale supplier or write us for the names of our distributors in your locality.

DAZOR *Floating* LAMPS

FLUORESCENT *and* INCANDESCENT

Illustrated above is a Hostess serving tray, "Hawley-made" of RESIN FIBRE PLASTIC, now being used on all major airlines. Appearance is as important an asset as its lightness, strength, and durability to withstand repeated hard usage.

...With the plans of today. Plans that are being confronted by problems of new materials for the many forthcoming product improvements. In RESIN FIBRE PLASTICS will be found the solution to Plastic Designers' and Manufacturers' problems in moulding large surfaces, difficult contours, and uniform thickness.

RESIN FIBRE PLASTICS also possess the diversified adaptabilities of precision to close tolerances, an ever-present "must" in the manufacture of small items. The scope of this versatile product covers many problems in the Aviation, Radio, Automotive and kindred industries that are always searching for stronger and lighter materials to improve their products. We will be happy to acquaint you with more specific details upon inquiry.

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THE GREATEST CONTRIBUTION IN THE GROWING BATTLE AGAINST MOISTURE-VAPOR

The protecting hand of "Plastin" now assures the Armed Forces of freedom from the ravages of moisture-vapor. You will welcome full knowledge of heat-sealing "Plastin", which is remarkably strong and remains flexible at low temperatures.

Literature is available, showing "Plastin's" importance to every manufacturer of any product which is subject to moisture-vapor attack. To be among the first to learn complete details of this unique development, send us your name and address.

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FABRICATED or MOLDED

Before "FREEZING YOUR DESIGN"
in plastics, call on us for an impartial, unbiased opinion
as to choice of materials or method of manufacture
Be assured there are no obligations for this service.

For your tough plastics problems
in compression, injection, transfer
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PLYOPHEN

Developed especially for the production of laminated tubing, No. 5016 Plyophen has proved its worth in flat sheet stock production as well. When used for heavy-wall tubing this phenol-base varnish permits production of tubing without the cracks that often follow curing. To either tubing or flat sheet stock it imparts high water resistance and mechanical strength. For information on this valued member of RCI's versatile Plyophen family of phenolic resins write direct to the Sales Department.

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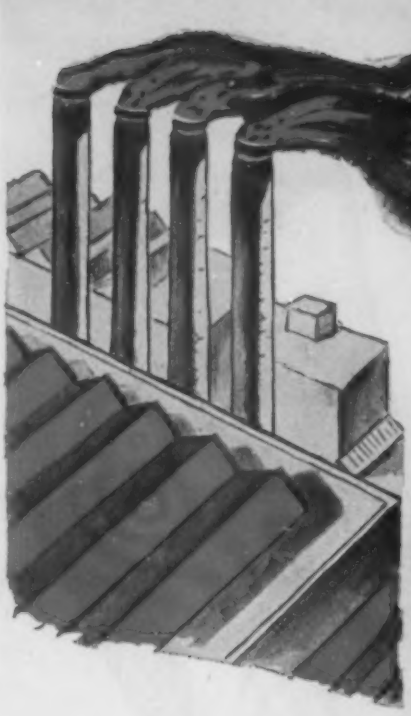
SYNTHETIC RESINS • CHEMICAL COLORS • INDUSTRIAL PLASTICS • INDUSTRIAL CHEMICALS



DON'T LET PRE-WAR METHODS KILL POST-WAR PROSPERITY!

The war years have proven to American Industry that the light machine tool has an important place in Production. Walker-Turner machine tools have demonstrated their ruggedness under most exacting conditions.

Don't let pre-war operating methods affect your post-war competitive position. The versatility of Walker-Turner machine tools will ensure production equal to—and, in many cases, better than—heavier and more expensive equipment.

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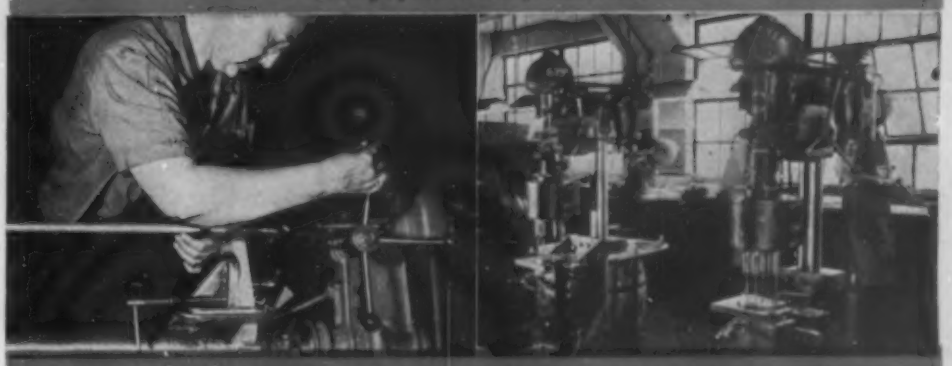
HERE'S HOW WALKER-TURNER MACHINE-TOOLS CUT COSTS!

260-5200 R.P.M. 60-5300 S.F.M. 160-8300 R.P.M.

Wide range of operating speeds enables you to select the optimum cutting speed for any material.



Walker-Turner flexibility saves time and cuts costs in special tooling set-ups.

Set up horizontally, this Walker-Turner 15" Drill Press flares the ends of tubing.

This Walker-Turner 20" Drill Press drills five holes and reams two holes in one operation.

Low power consumption reduces operating costs.

This motor on a Walker-Turner 20" Drill Press provides speeds for drilling up to ¾" in steel, 1" in cast iron.

Low price decreases capital investment.

This Walker-Turner 4-spindle 20" Drill Press costs no more than a single heavy unit, yet has several times its production capacity.

walker-Turner COMPANY, Inc. PLAINFIELD, N.J. U.S.A.

MACHINE TOOLS

DRILL PRESSES — HAND AND POWER FEED • RADIAL DRILLS
METAL-CUTTING BAND SAWS • POLISHING LATHES • FLEXIBLE SHAFT MACHINES
RADIAL CUT-OFF MACHINES FOR METAL • MOTORS • BELT & DISC SURFACERS

THE PLASTICS INDUSTRY HAS A SOFT SPOT FOR HARD CHROMIUM PLATING!

Hard chromium plating, for example, doubles the life span of plastic molds . . . multiplies the wear-resistance of hydraulic press rams . . . increases, tremendously, the performance factor of pumps and their packings . . . ups their stroke cycle as much as 25% per minute . . . creates measurably less friction loss between rams and packing . . . protects the working surfaces of roller mills . . . safeguards the use-value of machine parts, etc., etc.

Little wonder, therefor, as to why the industry's leading plant superintendents have a soft spot for hard chromium plating! . . . The process as developed and applied by IHC* for establishing maximum protection is also delivering superior performance. Result-wise, this type of service bonus pays!

Here, at IHC, plating for plastics requirements has grown into a highly specialized service, that asks very little extra time per assignment. Furthermore, through stripping and hard chromium replating, old dies and veteran parts can be restored to new life and long runs. More about these proven plating advantages . . . in fact, all about them . . . will be furnished to you promptly upon request. Inquiries invited.

INDUSTRIAL HARD CHROMIUM CO.

"Armorplate for Industry"

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Let our technicians help you with your post-war planning!

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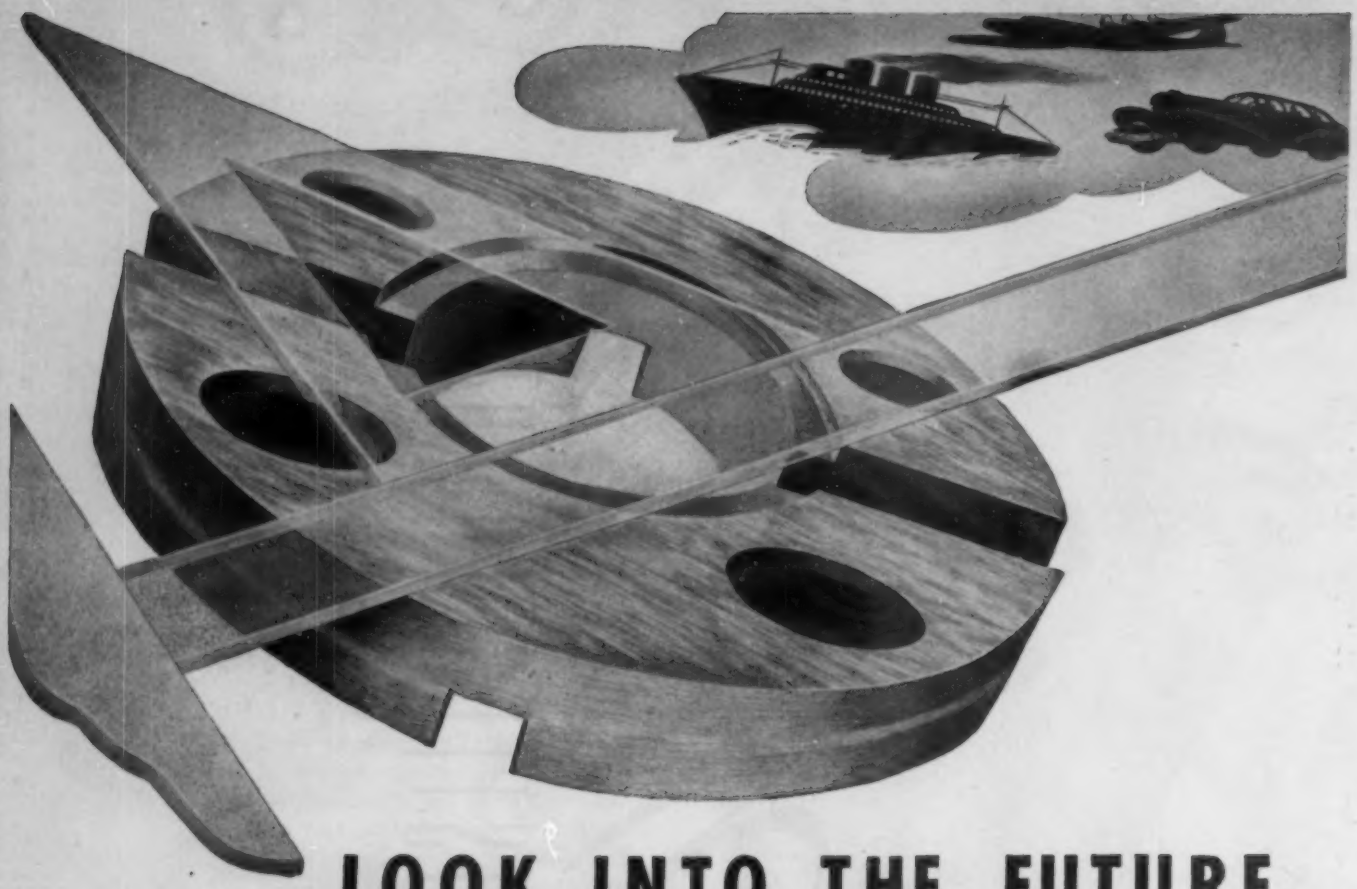

LOOK INTO THE FUTURE...

The VULCOID part illustrated is a magneto coupling. It must have great mechanical strength, be moisture resistant, insulate electrically; and have sufficient resilience to absorb the shocks of starting and stopping.

When you are projecting your future products Continental-Diamond Technicians can help you design for the appropriate NON-metallic material.

C-D manufactures 6 distinctly different types of NON-metallic materials. These materials have helped solve thousands of mechanical, electrical, chemical and thermal design problems.

Whether your requirements dictate *plastics, vulcanized fibre, mica* or some other type of NON-metallic material C-D "Know-how" can help you.

KC-45

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DILECTO—A Laminated Phenolic.
CELORON—A Molded Phenolic.
DILECTENE—A Pure Resin Plastic Especially Suited to U-H-F Insulation.
HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

The NON-Metallics

DIAMOND Vulcanized FIBRE
VULCOID—Resin Impregnated Vulcanized Fibre.
MICABOND—Built-Up Mica Electrical Insulation.

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Available in Standard Sheets, Rods and Tubes; and Parts Fabricated, Formed or Molded to Specifications.

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Continental-Diamond FIBRE COMPANY

Established 1895. . Manufacturers of Laminated Plastics since 1911—NEWARK 28 • DELAWARE

The First INDUSTRIAL

HIGH FREQUENCY DIELECTRIC HEATING EQUIPMENT

MODEL 28XO

Thermex, developed by Girdler, was the *first* practical industrial high frequency dielectric heating equipment produced. First in experience, Girdler engineers have been able not only to perfect a complete line of standard high frequency units for every dielectric heating purpose, but also to incorporate within that line specialized groups of models for specific industries. These Thermex Red Heads have been designed exclusively for plastics. They embody advantages which cannot be included in units designed for general use. They are backed up by unexcelled engineering and laboratory facilities in plastics heating which are at your service before, during, and after installation.

A THERMEX FIRST: Completely self-contained, automatic operation. Operator puts material in drawer. High frequency energy automatically goes on when drawer is closed, stops when required temperature is reached. No manual tuning, not even a starter button to push. Material is properly heated—uniformly, throughout its mass—in seconds. Molding time cycles are usually cut in half. Flaws and rejects are sharply reduced.

ANOTHER THERMEX FIRST: A new, compact unit, only 15 inches wide, 23 inches high, and 29 inches deep, which will fit in with the most compact existing arrangement of press equipment. Will serve the majority of press operations, one to each pair of presses alternately. Makes high frequency heating practical for large scale, production-line operation. Completely self-contained. Offers all of the advantages which distinguish larger models.

MODEL X875

SPECIFICATIONS

MODEL X875
400 watt rated output. Will raise ½ pound of average material 170° in one minute.

MODEL 18XO
750 watt rated output. Will raise ⅝ pound of average material 170° in one minute.

MODEL 28XO
1500 watt rated output. Will raise 1½ pounds of average material 170° in one minute.

MODEL 88XO
4.5 K.W. rated output. Will raise 4 pounds of average material 170° in one minute.

MODEL 165X
8 K.W. rated output. Will raise 7 pounds of average material 170° in one minute.

MAIL THE COUPON BELOW FOR FULL INFORMATION ABOUT THE COMPLETE LINE OF THERMEX RED HEADS

THE GIRDLER CORPORATION
Thermex Division, Dept. MP-3
Louisville 1, Ky.
Please send complete data about Thermex Red Heads.

Name.....

Firm Name.....

.....

Address.....

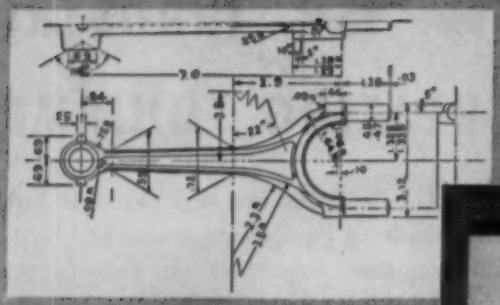
.....

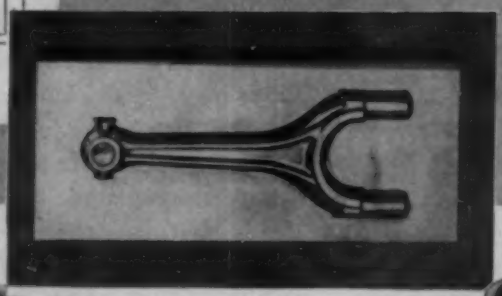
.....

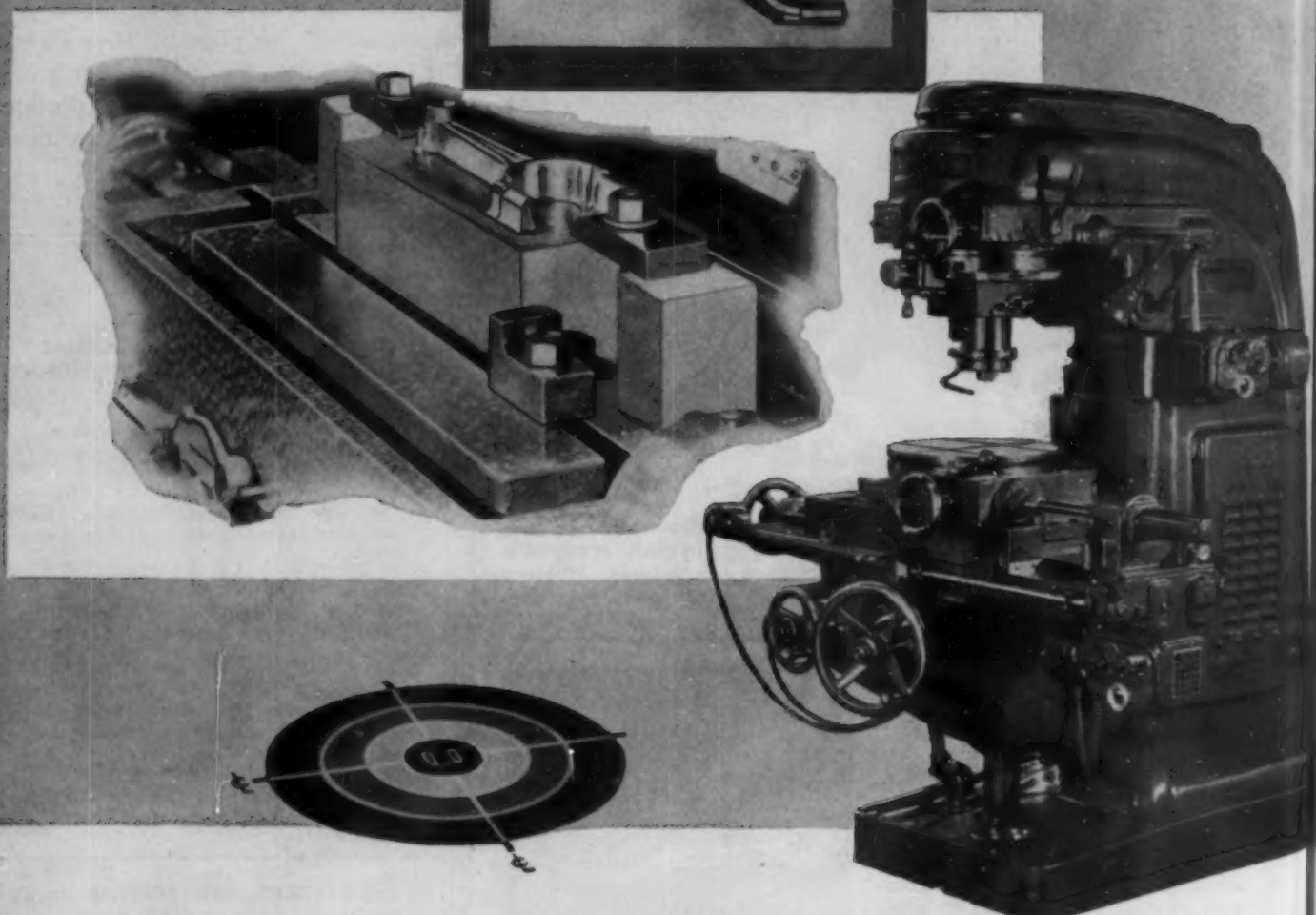
Thermex RED HEAD

DEVELOPED BY GIRDLER ESPECIALLY FOR PLASTICS

How Many Hours Would You Need to Mill this Master Hob?







Speed, economy and accuracy are typical performance features of a Milwaukee Rotary Head Milling Machine. The milling operation on this master hob is an excellent example. *Read this job report —*

MASTER HOB—MATERIAL—High Carbon—High Chrome Steel. TIME DISTRIBUTION—Set-up, ¾; Layout, 1¼; Rough Mill Complete, 10; Finish Mill Complete, 29. A total time of 41 hours.

Check these advantages of the Milwaukee Rotary Head Milling Machine and how you can benefit from them in your own shop:

DIRECT . . . mills mold cavities in a single set-up without the aid of templets or models.

ACCURATE . . . chances for error are eliminated because there is no change in set-up. Exact control of all combinations of cutting movements — possible only with this machine — transmits mathematical precision to the work.

FAST . . . initial job preparation and set-up time is reduced to the minimum. Accurate performance of the machine saves operator's time and rapid production of intricate molds and dies is the result.

Write for Bulletin No. 1002C and complete information.

BUILDERS OF MILWAUKEE ROTARY HEAD MILLING MACHINE • MIDGETMILL • SPEEDMILL • FACE MILL GRINDER • AUTOMETRIC JIG BORER • CENTER SCOPE.

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CORPORATION

Milwaukee 14, Wisconsin

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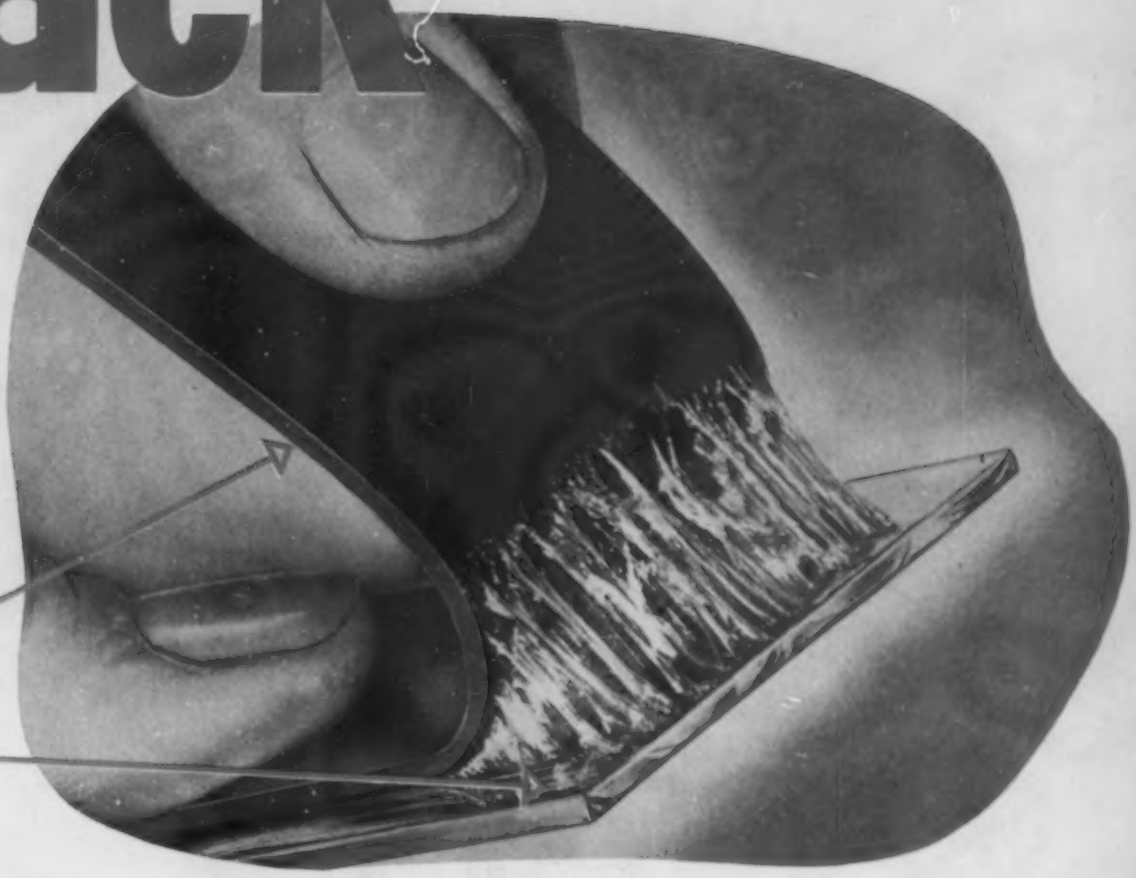
Tack



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CORDO-TACK Adhesives are particularly suitable where quick and permanent adhesion is desired. (CORDO-BOND Adhesives should be used for high bond strength.)

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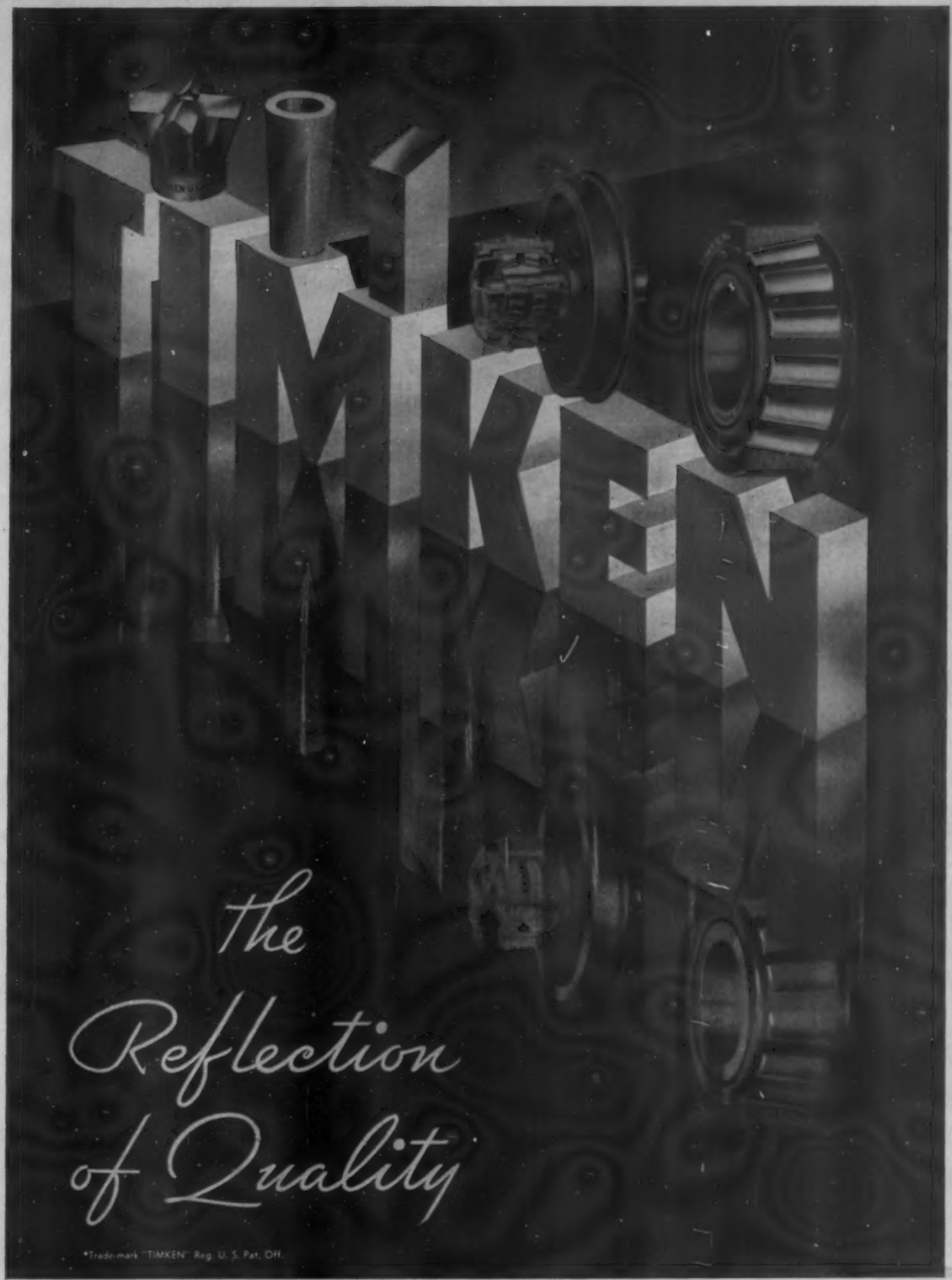
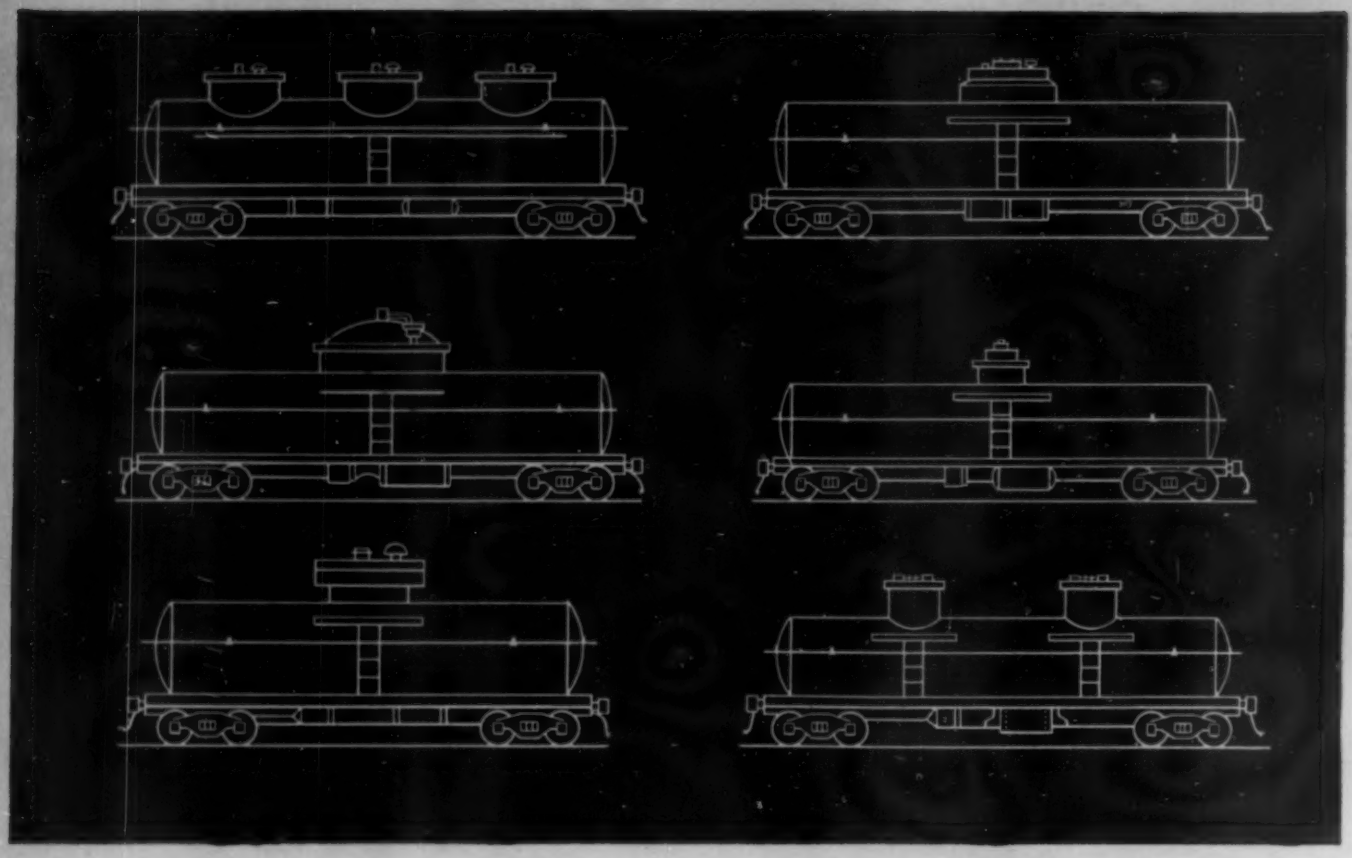


TIMKEN Tapered Roller Bearings | **TIMKEN** Alloy Steels | **TIMKEN** Seamless Steel Tubing | **TIMKEN** Railway Roller Bearings | **TIMKEN** Rock Bits

The Shape of Cars to Come



One of these may be the General American car built specifically to handle your new liquid or gas product.

It doesn't look very different. Yet, it may have unusual new features in lining or insulation—in temperature or pressure control — for safe handling of a product never before carried in bulk.

No matter how hard-to-handle your commodity may be, General American design and construction will give low-cost, efficient transportation.

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"IT'S AN ALLIED PRODUCT" . . . Allied Products Corporation and its divisions, Richard Brothers and Victor-Peninsular, in Detroit and Hillsdale, Michigan, also make: steam-heated plastic molds, sheet metal dies (from the largest to the smallest), cold forged parts, hardened and precision ground parts, cap screws, jigs and fixtures and special production tools.

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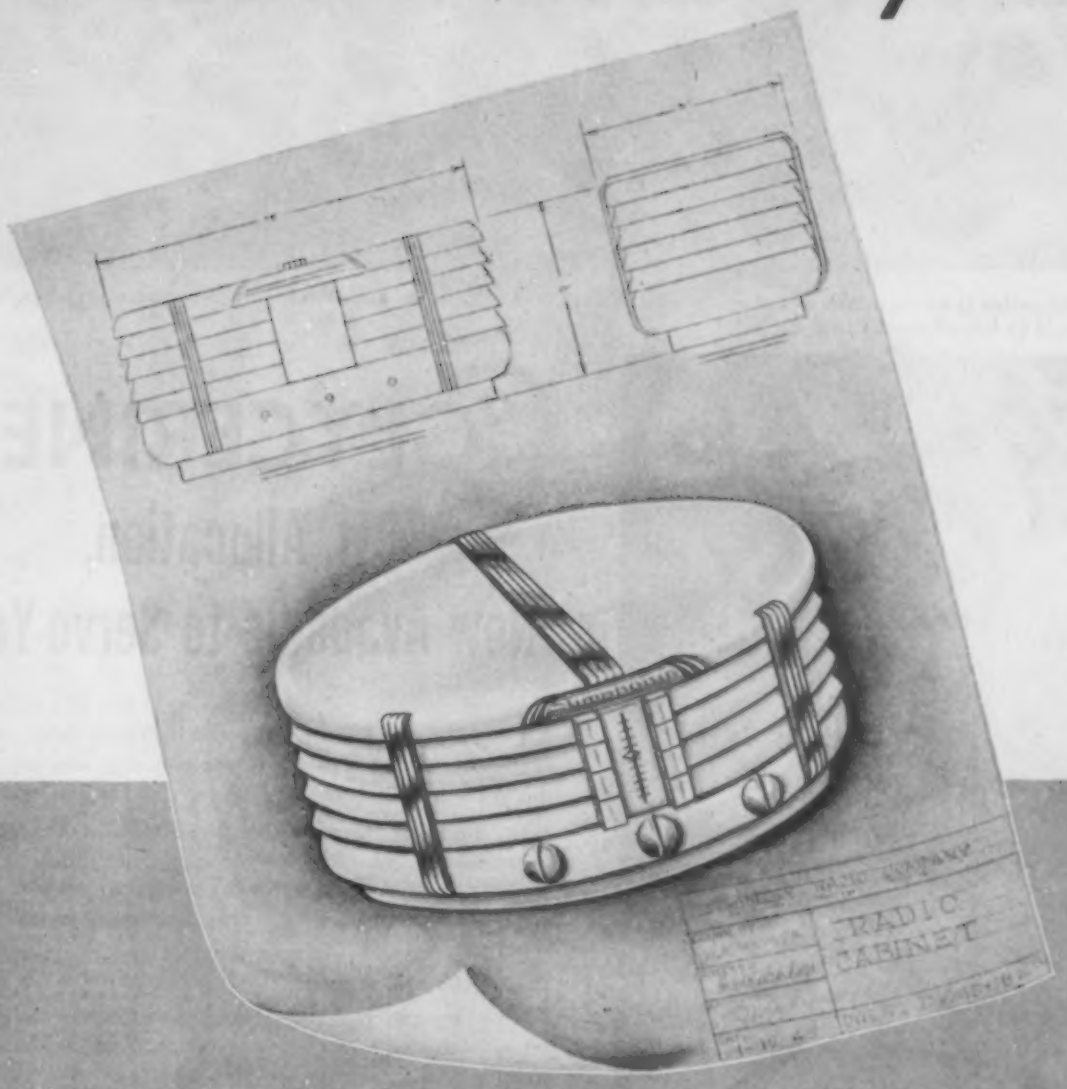
DESIGN WITH *Metaplate*



Combine the beauties of plastic and metal by Metaplating metal trim on plastic bodies. Metaplating, a patented process for electroplating metals on plastics, makes possible the patterning of metals and plastics inexpensively . . . only limited by the limits of your design artist.

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Metaplast Process Patented and Licensed

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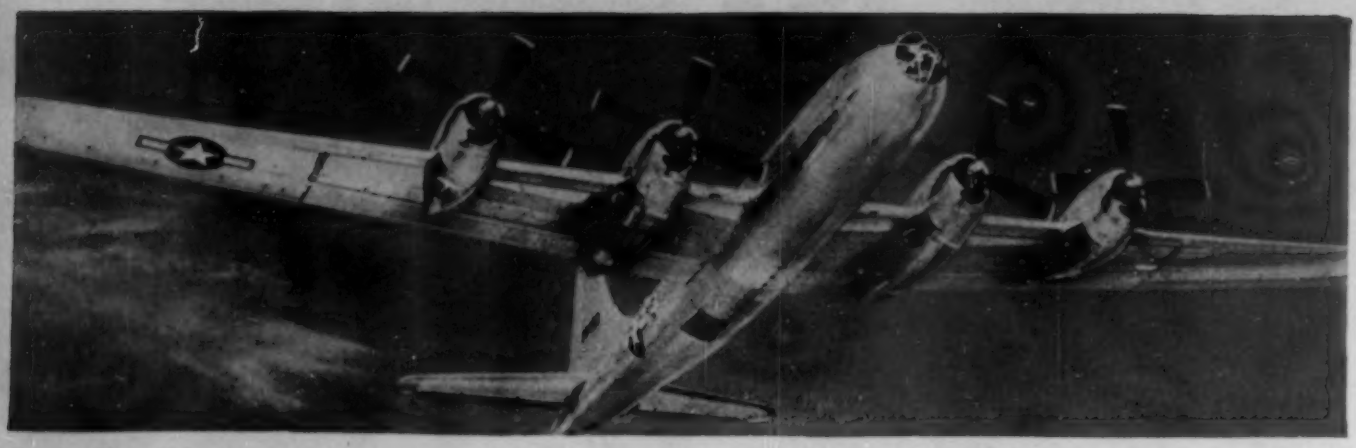

Keeping Them Up! Glycerine is an important part of mechanical gaskets. Without gaskets made flexible by glycerine, many aircraft, truck, and tank engines would be less efficient. Use glycerine!

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GLYCERINE

Off Allocation, Now Available to Serve You!

NOTHING takes the place of glycerine in war. It's used in making explosives and plastics and hydraulic fluids and lubricants. Glycerine, because it is wholesome, is also important in the making of foods and medicines, vitamins and textiles.

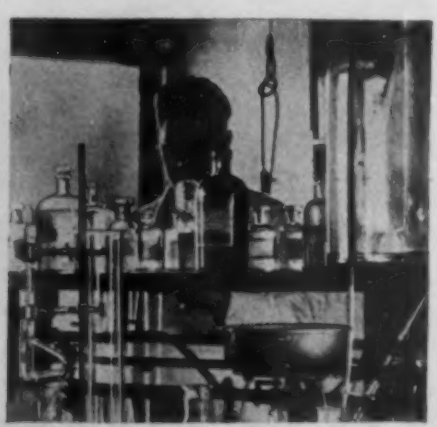
The Surgeon General's Office, the Medical Corps, and other governmental agencies recognize the necessity of using glycerine in many instances where human life is concerned. Another reason why war needs for glycerine have come first.

But now there is glycerine for making civilian goods also. That's good news for you.

If you have been using emergency substitutes, you'll want to get back to safe time-proven glycerine. And in planning new products you'll want to use glycerine too. Send for the free booklet "Nothing Takes the Place of Glycerine—1583 Ways to Use It." Address: Glycerine Producers Association, 295 Madison Avenue, New York 17, N. Y. Dept. J-4.

Better War Paint! Alkyd resins which help provide a tough, durable finish in long-lasting paints for ships, planes, tanks, and other equipment, are made with glycerine.

Safe Near Wounds! Glycerine is an important part of adhesives used on surgical tape. It is safe in pharmaceuticals, too. Use time-tested glycerine in your products!



New as Tomorrow! Versatile glycerine is finding ever new uses in the making of foods, drugs, vitamins, cosmetics, paints, and many other products. Use glycerine—*and be sure!*

TINY, THIN-WALLED BOBBINS

MOLDED OF NYLON...SIX AT A TIME.

The extreme thin wall structures of these fine-wire winding bobbins were *easy* for Nylon . . . but *hard* for the molder.

Nylon, when heated to molding temperature, flows so freely that unless the die design, feed controls, technique and timing are all equal to the task . . . you're in for a stew of spews!

By way of the photo herewith Consolidated happily reports success with the assignment . . . and desires to make known the fact that its engineering staffs are well up on their plastics know-how. If you have a molding problem, Consolidated would appreciate your inquiry. .

Consolidated MOLDED PRODUCTS *Corporation*

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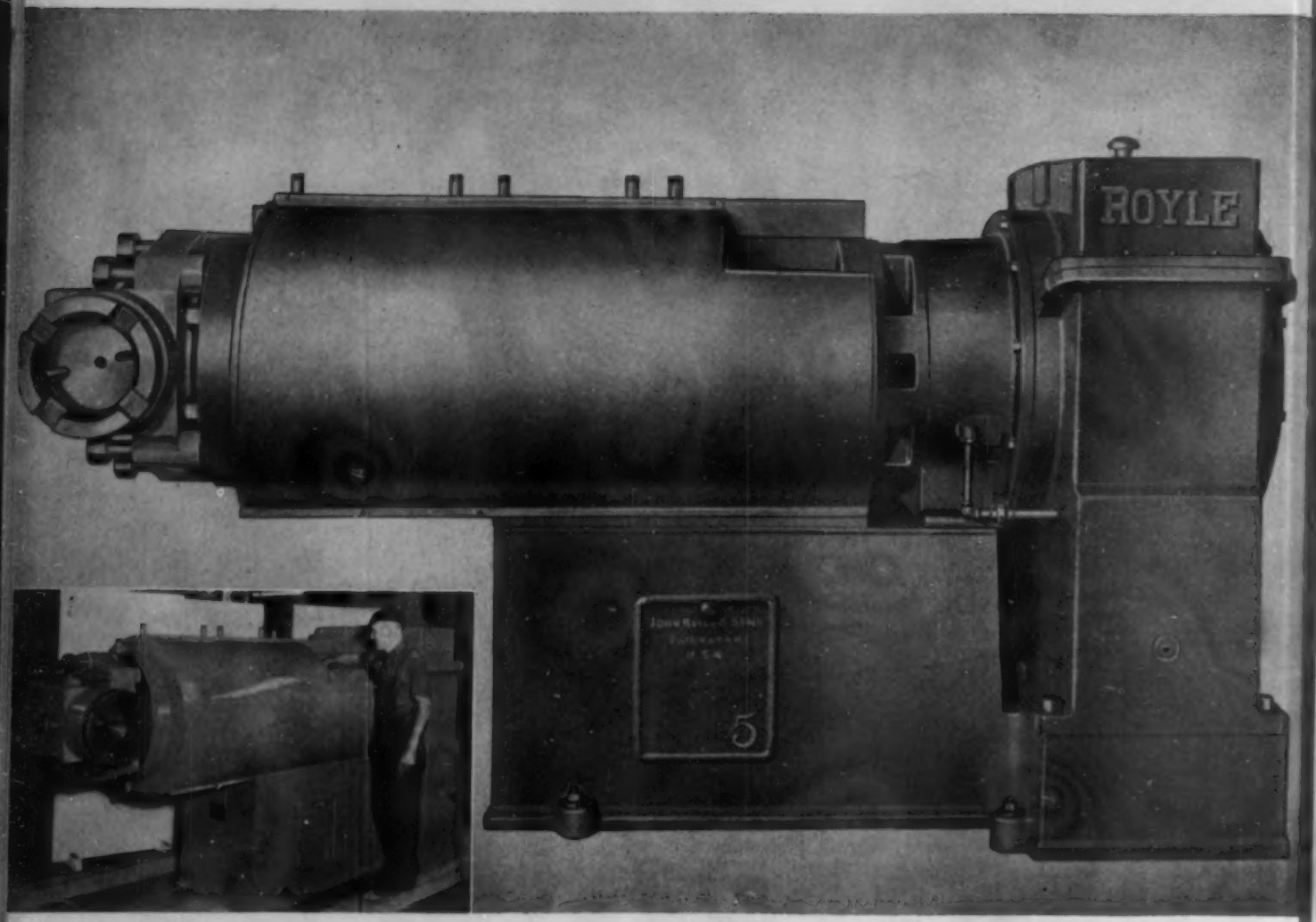

A lot of water has flowed over the dam since the first Royle Extruder was introduced sixty-five years ago. In 1880—and during the following decade—an impenetrable veil of secrecy existed. No extruder had ever been seen in operation nor had any report on production achievements ever been received.

That veil of secrecy is gone. In its place has come a spirit of wholesome cooperation. This cooperation makes it possible to design Royle Extrusion Machines to meet the specific requirements of the application involved. As always cooperation produces maximum results.

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For some time we have been working on a round-the-clock schedule. It keeps us pretty busy, so if we do not get around to see you as often as we used to, you'll understand that we are never too busy to discuss your problems with you, whether current or postwar.

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Such revolutionary production improvements are commonplace in *every* industry where coated abrasives in any form are used.

In the Plastics industry, our Field Engineers have been particularly active in recommending time-saving shortcuts in sanding and finishing methods. Just a line to our nearest branch or to our home office will bring this service to you. There is neither charge nor obligation.

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Depend on Du Pont also for: PARAFORMALDEHYDE—powdered or granulated, 95% minimum strength. And HEXAMETHYLENETETRAMINE—U.S.P. crystals or technical. Our nearest district office will be glad to consult with you about delivering your needs. Information and technical assistance on using Du Pont Formaldehyde are available directly from the Electrochemicals Department, E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.

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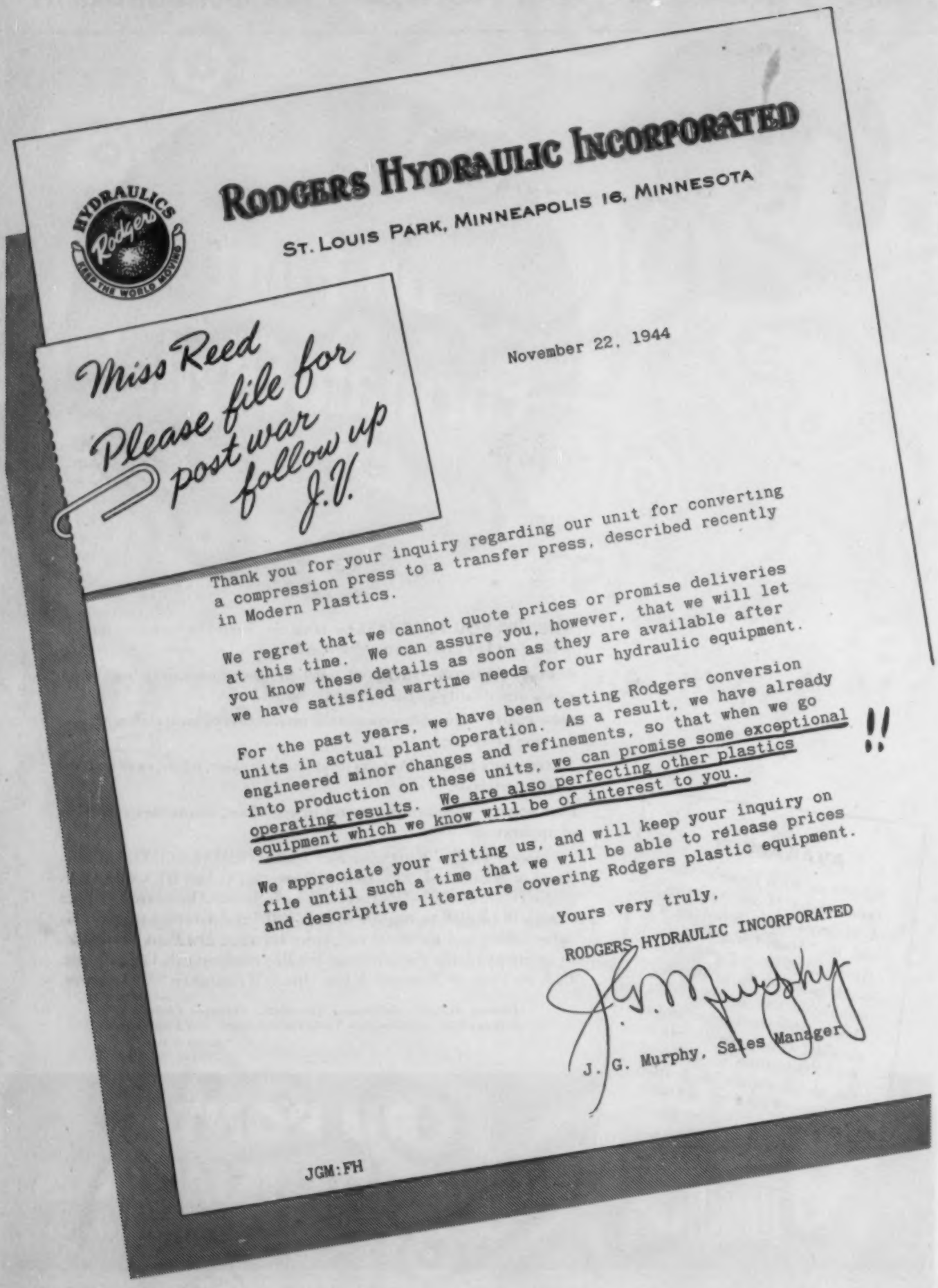

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ST. LOUIS PARK, MINNEAPOLIS 16, MINNESOTA

Miss Reed
Please file for
post war
follow up
J.V.

November 22, 1944

Thank you for your inquiry regarding our unit for converting a compression press to a transfer press, described recently in Modern Plastics.

We regret that we cannot quote prices or promise deliveries at this time. We can assure you, however, that we will let you know these details as soon as they are available after we have satisfied wartime needs for our hydraulic equipment.

For the past years, we have been testing Rodgers conversion units in actual plant operation. As a result, we have already engineered minor changes and refinements, so that when we go into production on these units, we can promise some exceptional operating results. We are also perfecting other plastics equipment which we know will be of interest to you. !!

We appreciate your writing us, and will keep your inquiry on file until such a time that we will be able to release prices and descriptive literature covering Rodgers plastic equipment.

Yours very truly,

RODGERS HYDRAULIC INCORPORATED

J. G. Murphy

J. G. Murphy, Sales Manager

JGM:FH

These punches made of *Graph-Mo Steel* produced *140,000* extra pieces . . . .

These punches were made from Graph-Mo Steel by the Precision Manufacturing Company of Philadelphia, Pa. for John J. Nesbitt, Inc., and are used in a progressive set up that produces 2,000 blanks an hour. Before the punches were made of Graph-Mo Steel breakage was a serious problem and the maximum life was 10,000 pieces. Punches made of Graph-Mo produced 100,000 to 150,000 pieces before needing attention and none broke in service.

In addition to providing 700 extra hours of service Graph-Mo, because of its excellent machinability saved 30% in machining time.

When you want longer tool and die life and increased production specify Graph-Mo an oil hardening steel or one of the five famous Timken Graphitic Steels. They all have good machinability, are very responsive to heat treatment and offer stubborn resistance to wear and abrasion. A request on your firm's letterhead will bring a 48 page book that tells how and where to use these performance proven steels. Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.

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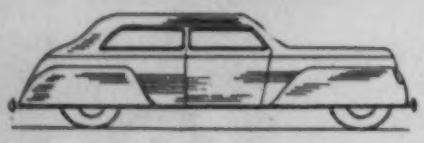
This viewing hood for protection at sea against all weather is one of the recent applications of Riegel-X — already firmly established in many industries.

Looking ahead, it will be refrigerators, automobiles, furniture, pre-fabricated homes, boats, and probably certain functional parts of your product too.

For Riegel-X Plastic Laminates are primarily functional. They contribute a new design material that gives light-weight strength, higher insulation, increased dielectric properties, fire resistance, precise fabrication and many other basic qualities.

Unless you have an acceptable end use, our mills cannot help you now. But our engineers can — with a wealth of experience that is yours for the asking. Write to Riegel Paper Corporation, 342 Madison Avenue, New York 17, N. Y.



FOR INSTANCE

Auto manufacturers are now experimenting with Riegel-X in the construction of auto bodies.

RIEGEL-X

X A group of plain and impregnated base papers for high or low pressure laminates X

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Our organization is composed of trained engineers . . . men who are fitted by education and experience to handle all types of plastics molding problems. Every job molded by Universal is *engineered* from start to finish by men who know plastics . . . the best materials to use . . . compression and injection molding and finishing operations. If your production, present or postwar, would benefit by this sort of sound engineering practice, we suggest a conference with our Planning Division. A request for a conference would involve no obligation on your part.

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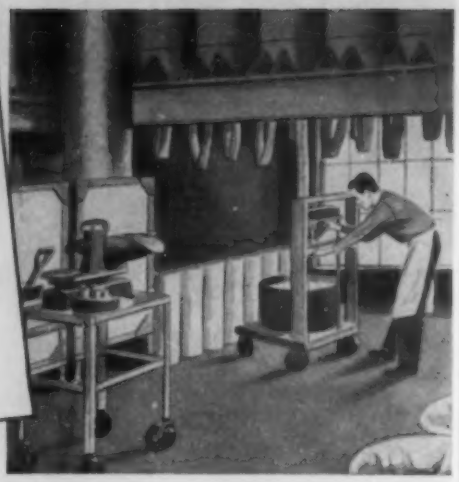
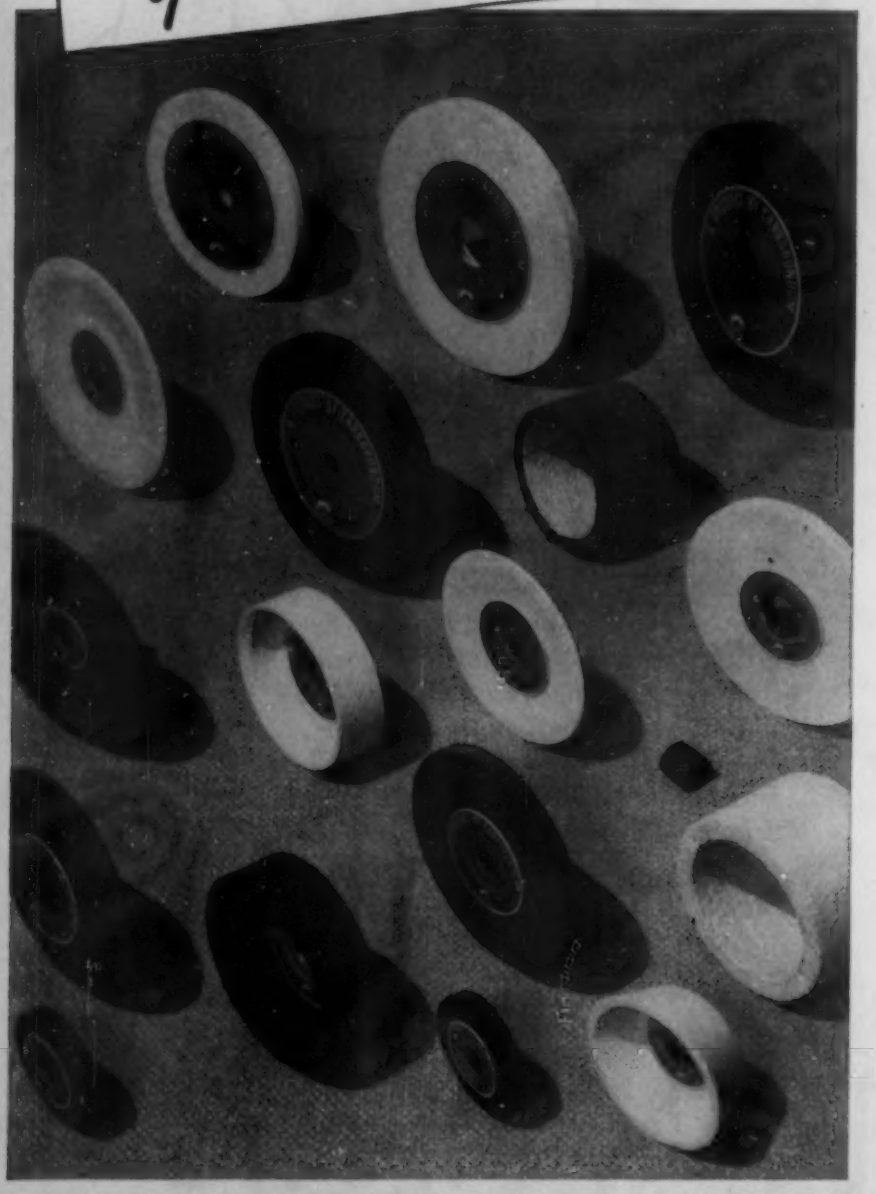
How to take the Guesswork out of your Abrasive Problems!





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Of course, to select exactly the right abrasive for even the most difficult job, you can always obtain the help and advice of the "CARBORUNDUM" Abrasive Engineer. He's a man whose experience covers abrasives from "A" to "Z." The chances are a "CARBORUNDUM" representative can be a big help to you—he has been to many others.

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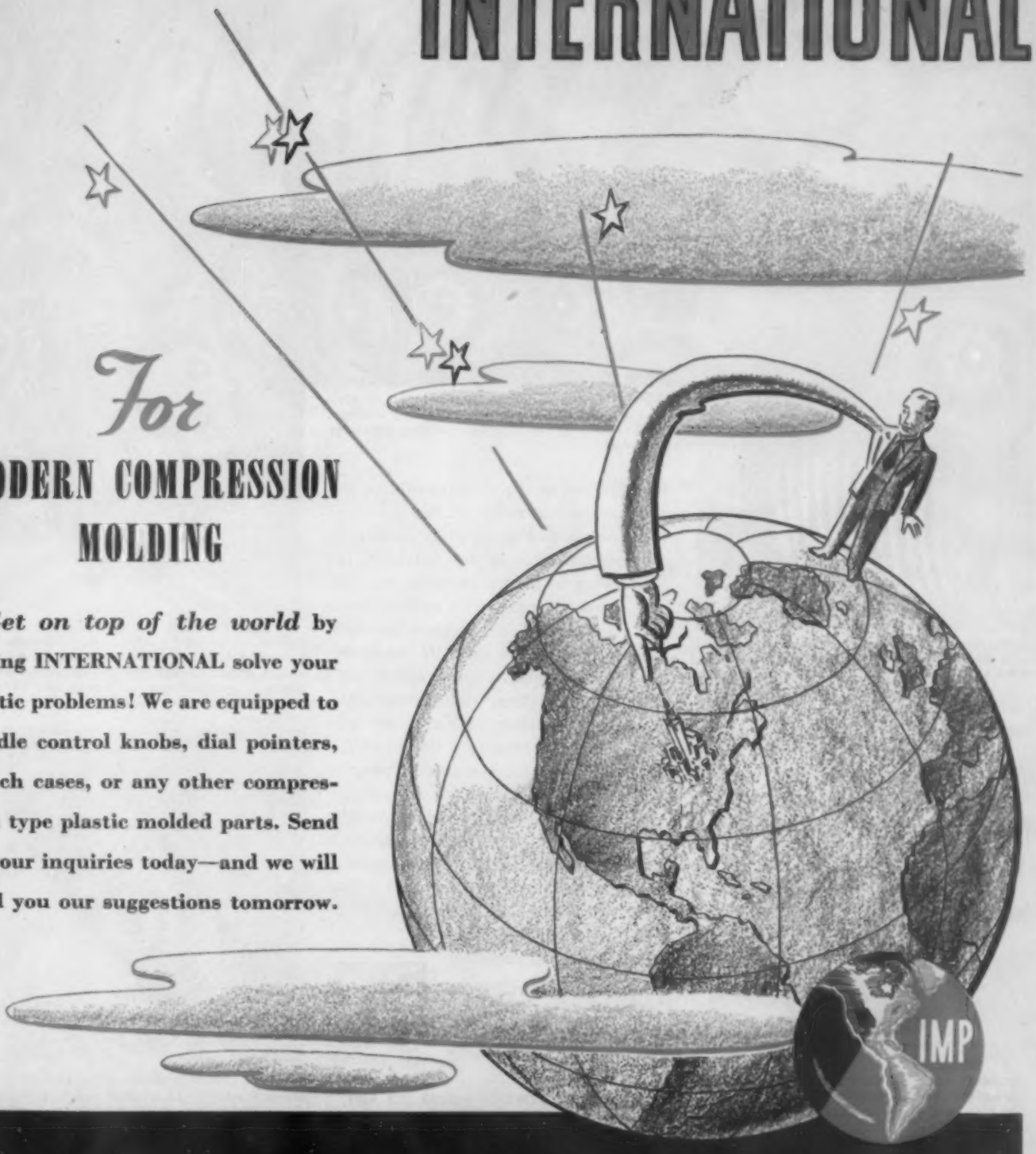

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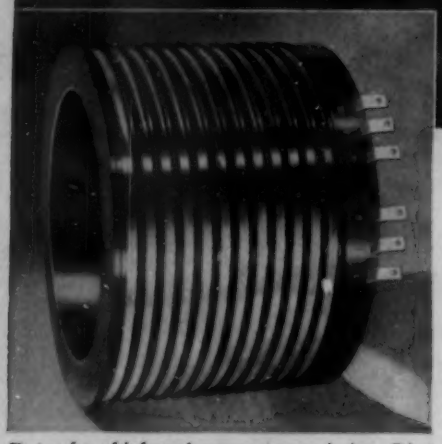
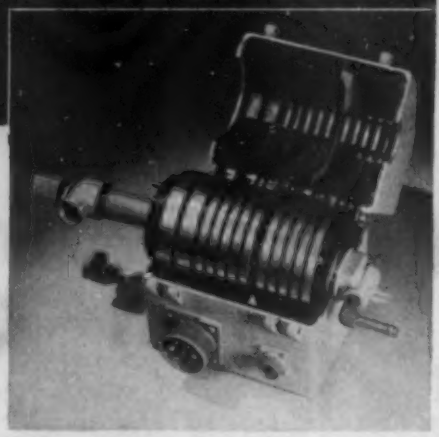
COMBINING PLASTICS & METALS *in Molded* ROTORS

(Above) Rotor designed for top turret of Flying Fortress. Wires are molded in, and covered by at least 3/32" of plastic, providing excellent insulation.



Rotor for shipboard power transmission. Ring, wire and lug assemblies, mounting inserts and steel sleeve at center are molded in position. Transfer molded of high impact macerated fabric material.



Turret swivel joint for Navy patrol bomber gun turrets. Transmits power, supplies oxygen, connects radio and telephone circuits. Rotor assembly is in two sections — 1 5-ring, and 1 7-ring. Housing is transfer molded phenolic piece.

These rotors, or slip ring assemblies, are outstanding examples of the practical value of plastics and metals molded in combination. Rotors are essential requirements for the transmission of power to a revolving part, such as the power operated turrets of military aircraft. Essential operation and life itself depend on smooth, uninterrupted performance from these transmitting units. By transfer-molding the rotors, we save machining and assembly time and incorporate the best features of plastics and complementary metals.

Rings, wire and lug assemblies are combined in single units perfectly aligned. A molded rotor assembly has superior properties as to permanence of alignment, resistance to weather, temperature and vibration. The engineering and molding experience which has produced these improvements will be available for your postwar products.

PM
REG. U.S. PAT. OFF.

Cut-away view of swivel joint assembly designed for installation in 4½" turret space. The rotor and stator are molded and assembled complete.

Slip ring assembly designed for aircraft. Transfer-molded with 22 rings of copper alloy, silver finished for improved contact and corrosion resistance.

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CANADA—A. & M. Accessories Ltd., 19 Melinda Street, Toronto; 1405 Bishop Street, Montreal; 920 Second Avenue, Seattle

FOR ARC-RESISTANCE

Specify RESIMENE 803A

Arc resistance in peacetime applications will be as important on many occasions as it has been in battle. Where it is, you'll want to use RESIMENE 803-a, the Monsanto melamine molding compound which has proved it sability to withstand the higher voltage differentials and severe operating conditions frequently found in wartime electrical equipment.

RESIMENE 803-a is a cellulose filled compound combining the well-recognized arc-resistant qualities of melamine resins with excellent moldability and good mechanical properties formerly expected only in general purpose phenolic compounds.

The fact is, RESIMENE 803-a has an arc resistance of 120 seconds (ASTM-D495-41), thirty to forty times that of phenolics.

Ask for complete information on RESIMENE 803-a and other RESIMENE formulations from Monsanto's plastics consultants. Write, wire or phone: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Massachusetts.

Other characteristics of the entire group of Monsanto's RESIMENE molding compounds and industrial resins:

1. HIGH HEAT RESISTANCE
2. EXCELLENT ABRASION RESISTANCE
3. LOW WATER ABSORPTION
4. FREEDOM FROM TASTE AND ODOR
5. RESISTANCE TO WIDE RANGE OF CHEMICALS
6. HIGH TENSILE AND COMPRESSIVE STRENGTH
7. EXCELLENT WEATHER RESISTANCE

The broad and versatile Family of Monsanto Plastics includes: Lustron polystyrenes • Cerex heat resistant thermoplastics • Vinyl acetals • Nitron cellulose nitrates • Fibestos cellulose acetates • Resinox phenolics • Resimene melamines • Forms in which they are supplied include: Sheets • Rods Tubes • Molding Compounds • Industrial Resins • Coating Compounds Vuepak rigid, transparent packaging materials.

MONSANTO PLASTICS

SERVING INDUSTRY...WHICH SERVES MANKIND

INJECTION MOLDING

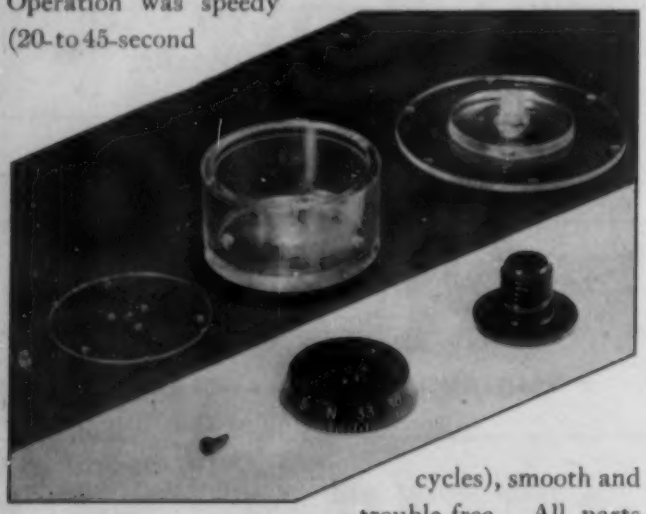
NUMBER THREE OF A SERIES

IT IS NOT uncommon in the plastics industry for an advertiser to show a fine looking plastic product and then describe, at considerable length, the difficulties surmounted in its manufacture.

Just for contrast, we here present a group of moldings which gave nobody any gray hair; and we explain this phenomenon by quoting the molder as follows:

"There was nothing particularly difficult about this job because we made all the parts on a Lester."

These are the plastic parts of the famed Sherrill compass, made of acrylics and butyrates by the Michigan Molded Plastics Company for the designer and manufacturer, the Sherrill Research Corporation. Ranging in weight from 1½ grams to 136 grams and meeting dimensional tolerances as fine as .001", all the moldings shown were turned out by a six-ounce Lester. Operation was speedy (20-to-45-second



cycles), smooth and trouble-free. All parts were exceptionally clean as they came from the molds.

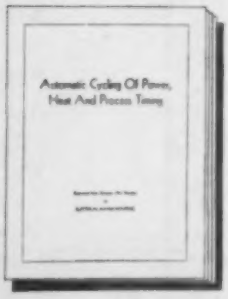
We're proud of this job (and many another), not because our machine performed any miracle in doing it, but because it performed another of its everyday tasks efficiently, quietly and without delay or difficulty. We invite you to take a big step toward simplifying *your* molding problems by writing for more information on Lester injection molding machines.

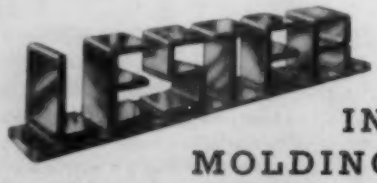
Shown at right above is the six-ounce Lester injection molding machine, which, like all Lester machines, has the following exclusive engineering features: (1) *Vertical heating cylinder* with hollow injection plunger, which delivers more material into the mold at higher pressure

per energy input than any other machine; (2) *Cylinder is interchangeable* with others of various capacities, increasing molding range; (3) *Massive alloy-steel beam frame* gives 3 to 5 times the strength and rigidity offered by ordinary bar-type construction; (4) *Positive mold locking* virtually eliminates flash; (5) *Central die adjustment* is easy to operate and assures constant and absolute parallelism of mold platens. The Lester machine is also made in 4, 8, 12, 16 and 22-ounce models.

You'll Be Interested in This:

Our article, "Automatic Cycling of Power, Heat and Process Timing," reprinted from *Electrical Manufacturing*, is full of pertinent data on the function of Lester machines. We shall be glad to send you a copy of this reprint, as well as any other information which you may desire. Just write to:





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● BAKER PLASTICIZERS CONTAIN NO PHTHALATE

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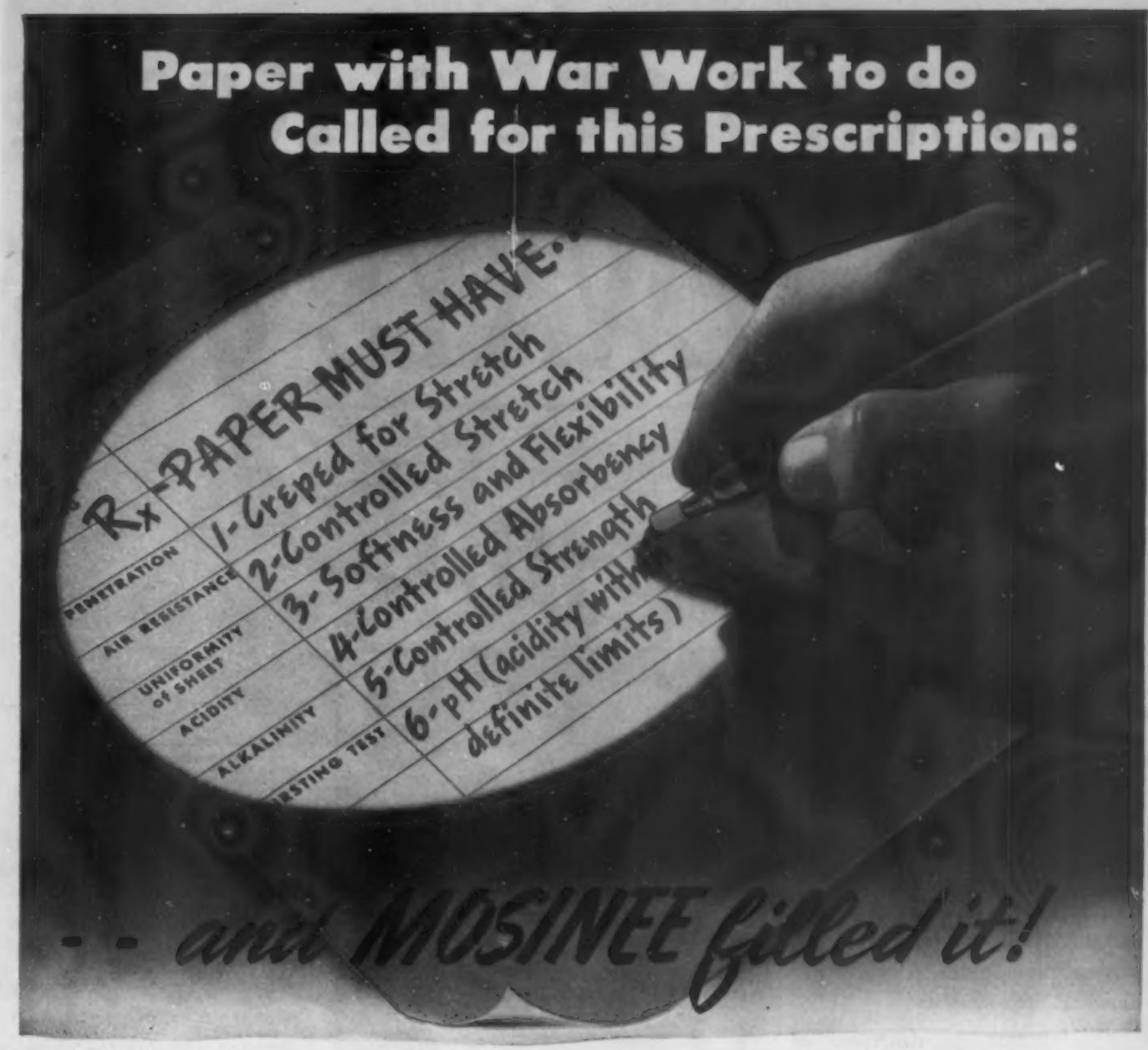
Paper with War Work to do Called for this Prescription:



Adjustments in paper specifications advanced the success of many products in war work . . . and a change in paper density, absorbency, pliability, moisture-vapor repellency, greaseproofness or dielectric strength might help advance the postwar opportunities of *your* products.

MOSINEE can be engineered to give the technical characteristics you need in paper . . . to avoid processing "headaches" . . . to improve your products, boost production and lower costs. Mosinee engineers, at your request and without obligation to you, are available for consultation.

Please address your letter "Attention Dept. A"

MOSINEE PAPER MILLS COMPANY
MOSINEE • WISCONSIN
Essential Paper Makers

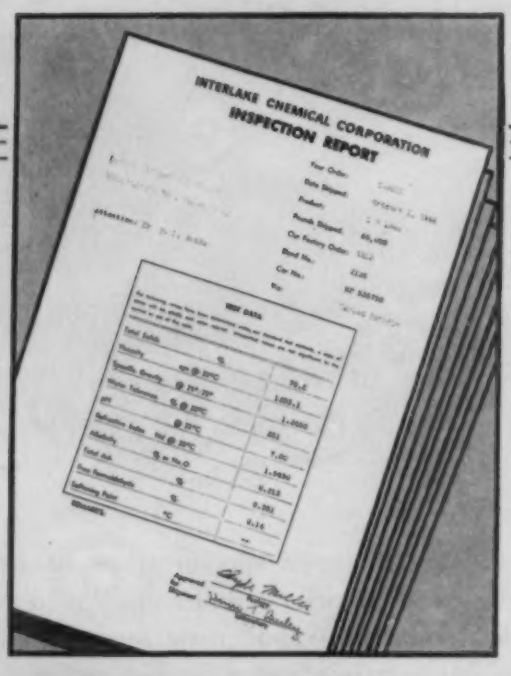
How to get a Resin that ALWAYS does its job!

☆ ☆ ☆ ☆ ☆

THE QUALITY of the raw materials—as much as the technical knowledge and skill employed in the production of resins themselves—determines finished resin quality.

The production of phenol, ortho-cresol, metapara cresol, etc., the synthesizing of the finished resins, and the adjustment to and stabilization of each resin for its specific job, are all *exacting chemical operations* affecting final quality and performance.

Interlake Chemical, as a manufacturer of these raw materials and as a producer of finished resins, knows the importance of clean cut control* of both chemicals and resins. This knowledge and experience is assurance that an Interlake resin will *always* do its job.



☆ ☆ ☆ ☆

The extremely close range of variation within which Interlake Specification Resins are held is evidenced by control laboratory inspection report, with each shipment, showing the chemical characteristics of the resin.

HAVE YOU A RESIN PROBLEM? Draw freely upon the wide experience of Interlake. We will gladly work with you on any resin problem, or discuss with you the possible advantage of using resins in any operation or process. Write Interlake Chemical Corporation, Plastics Division, Dept. 12, Union Commerce Building, Cleveland 14, Ohio.

INTERLAKE CHEMICAL
Corporation
PLASTICS DIVISION

Specificity IN RESINS

Ever see a Mold with Invisible Cavities?

WE USED TO MOLD 96 switch housings in an 8 hour shift with this mold. Now we turn out 200—all with the same 14 inserts. The plastic material is cured better than before. We use the same press. It's like having a couple of extra cavities you can't see.

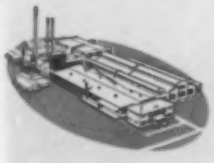
That's what Heatronics (radio-frequency preheating) has done for one of our jobs. For others, it has allowed thicker wall sections—lower molding pressures (sometimes on lighter presses)—more simplified processes. It has even made feasible new applications that we used to shy away from before.

So this is a good time to re-assess your molding program in the light of what Heatronics can do for you. We can help with this at Kurz-Kasch because we've gone into Heatronics more thoroughly than most. In fact, we began with the *first* RCA unit, and now have one of the largest, fastest-growing installations in the industry.

More important, we've had the type of experience that comes from sharing in Heatronics development. We can apply to your problem every advantage that it offers today. With our 28-year-old name for leadership in the plastics industry—plus one of the largest, best-equipped custom plants in the country—that is just one more reason to see Kurz-Kasch first for plastics. Ask for an engineer.

THE WAR BONDS YOU KEEP ARE THE BONDS THAT COUNT

Kurz-Kasch



For over 28 years Planners and Molders in Plastics

Kurz-Kasch, Inc., 1415 South Broadway, Dayton 1, Ohio. *Branch Sales Offices:* New York • Chicago • Detroit Indianapolis • Los Angeles • Dallas • St. Louis • Toronto, Canada. *Export Offices:* 89 Broad Street, New York City

Where the password is Precision

HERE at Precision Plastics Company, every operation from creative designing through to the final inspection is in the skillful hands of master craftsmen equipped with the most modern facilities.

At the inspection stage, illustrated, *precision is the password*, for no part or product gets passed for delivery unless it meets in every respect the most rigid specifications.

Add to that the fact that we render a really *personal* service and you have good reasons for keeping that name in mind—

PRECISION

PRECISION *Plastics Company*

4647-61 STENTON AVE., PHILADELPHIA 44, PA.

ELECTRONIC PREHEATING STEPS UP OUTPUT AT CHICAGO DIE MOLD PLANT

CASE HISTORIES SHOW BIG PRODUCTION GAINS WHEN NEW METHOD AIDS MOLDING

Chicago Die Mold Company's first RCA electronic generator was installed many months ago to break a bottleneck in the production of a highly important molded piece for the armed forces. Output from the molding press was immediately stepped up from 18 shots per hour to 32! Here are the details:

THE PART: See photo, lower right.

MATERIAL: Bakelite XM-15000 (very hard; medium-high impact resistance).

MOLDS: A 16-cavity mold. Washer-shaped preforms were placed in the cavities flatwise.

PREHEATING: Previously, preforms were heated in an electric oven.

PROBLEMS: The high-impact material tended to damage the hobbed cavities badly. A number of sunk cavities resulted from attempts to mold this part. Rejects were high. All these things put production behind schedule.

SOLUTION: One RCA, 2000-watt, electronic preheating unit was installed. Applicator was arranged to heat 16 preforms simultaneously. As mentioned above, production was greatly increased. Rejects were substantially reduced.

ADDITIONAL UNITS INSTALLED: The success of this first installation led to the purchase of seven additional units—the most recent being two RCA Model 2B generators especially designed for the plastics industry. According to Mr. E. A. Petersen, President of Chicago Die Mold, "we long ago ceased thinking of electronic preheating as 'experimental' and are using it extensively in a wide variety of molding work. The results obtained more than justify the cost of the equipment."

WHAT IS YOUR PROBLEM? If quick, uniform preheating and the resulting ideal plasticity can help you, or if you see other possible benefits to you, be sure to get in touch with us. Our engineers have had wide experience in the application of electronic heating to plastics; our plastics-molding operations in our own plant serve as an excellent "proving ground" for RCA equipment. Address inquiries to: RCA, Electronic Apparatus Section, Box 70-190-P, Camden, N. J.

View of latest RCA 2B units in plant of Chicago Die Mold Co., molding cover plate of BM-021. RCA electronic preheating unit beside press preheats complete charge (2 preforms weighing 204 grams) in 30 seconds.

Electronic preheating stepped output from 23 to 33 plates per hour, and reduced rejects to less than 10%.

◀ Note thick sections in this microphone case which is successfully molded with RCA electronic preheating. Material: BM-3510. Charge: ⅛ pound for 2 cavities. Preheating time: 22 seconds. Cure time: 2 minutes.

Production on this piece was ▶ increased from 18 to 32 shots per hour (16 pieces per shot) by electronic heating. See text for details.

RCA ELECTRONIC HEAT

RCA

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION, CAMDEN, N. J.

BUY MORE WAR BONDS

FREE

SEND FOR THESE BULLETINS

RCA, Electronic Apparatus Sect., Box 70-190P, Camden, N. J.

Please send me "Electronic Heating Speeds Plastics Molding" and "RCA Electronic Power Generator, Model 2B."

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CITY ..... ZONE ..... STATE .....

70-6256-190

*COSMETIC
*AVIATION
*CLOTHING
*FURNITURE
*RADIO
*AUTOMOTIVE
*MARINE
*ELECTRONIC
*LIQUOR
*NOVELTY
*DRUG
VERSATILITY*
". . . in meeting INDUSTRY'S needs!"
Broad indeed are the capabilities required, in this era, to satisfy the plastic molding demands of precision-minded engineers, designers and manufacturers. Yet MACK MOLDING, with three completely-equipped plants in Wayne, N. J., Arlington, Vt., and Waterloo, P.Q., Canada, is supplying the needs of multiple fields —from radio chassis to buttons, from household embellishment to aircraft components. Each necessitates individual characteristics and specializations all their own.
May we direct this versatility to your plastic molding requirements?
Inquiries should be addressed to MACK MOLDING COMPANY, 100 Main Street, Wayne, New Jersey.

LINCOLN HYDRAULIC SYSTEMS

for HYDRAULIC PRESSES

Illustrated at left is a Lincoln Hydraulic System operating an H. P. M. 18" Diameter Ram press—molding Phenolic Resin industrial truck wheels.

Lincoln Hydraulic Systems provide rapid daylight closing and automatically sustain selected molding pressures throughout any curing cycle without consumption of power—thus providing exceptional economy in operation. These systems are powered by the famous Lincoln Air Motor which has long proven its reliability and efficiency in many industrial applications and under the most adverse operating conditions.

H44-1

Hydraulic System Selection

Recommendations of the proper Lincoln System will be made by our Engineers upon receipt of the following information . . . Ram diameter—Maximum stroke—Platen size—Total weight of Platen, ram and dies—Distance and speed of daylight closing—Maximum compression stroke—P. S. I. ram pressure—Time of cycle desired—and any other related facts affecting operation.

●

BUY EXTRA WAR BONDS—NOW

LINCOLN BOOSTER PUMPS
for Hydraulic Systems

●

Selected high pressure automatically sustained without horsepower consumption—no by-passing or pressure relief valves.

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Pioneer Builders of Engineered Lubricating Equipment

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LINCOLN

Designing

. . . a service which offers your product added sales appeal. Tomorrow's market will look for and demand the last word in design. We are in a position to aid you in preparing for these markets. For post-war plastics think of Bridgeport.

BRIDGEPORT MOULDED PRODUCTS, INCORPORATED

BRIDGEPORT B CONNECTICUT

four important superiorities of

RESINOX-7934

for electrical applications
for military and naval end use

1. Low dielectric constant and power factor

Dielectric constant at 1 K.C.
— 4.35 to 4.50
Dielectric constant at 1 M.C.
— 4.20 to 4.50
Power factor at xx 1 K.C.
— 0.015 to 0.017
Power factor at xx 1 M.C.
— 0.0080 to 0.0085

2. Low water absorption

—only 0.030% by weight after 24 hours' immersion

3. Heat resistance

Relatively high heat resistance—important where leads are assembled to molded parts by a hot soldering iron.

4. Molding Superiority

Ease and economy in molding superior to ordinary mica-filled phenolics heretofore available to compression molders.

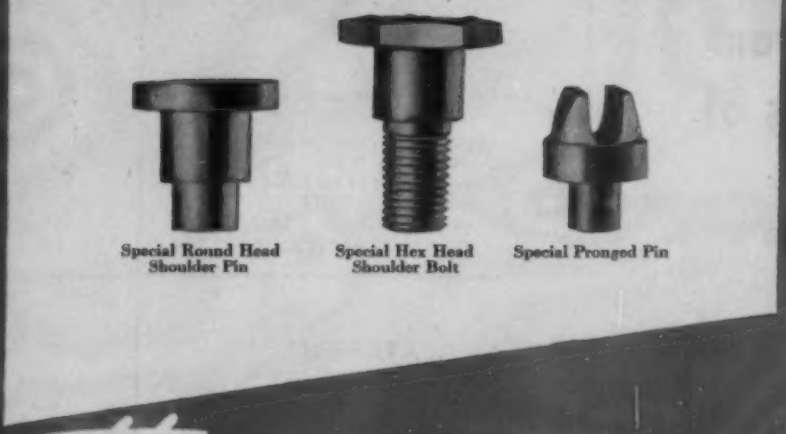
To provide unfailing insulation for medium and high frequency apparatus, under the severest operating conditions, including especially, high humidity . . . that's the war assignment of Resinox 7934.

This compound (mica-filled), based on a new phenol formaldehyde resin developed by Monsanto's plastic research, is *available now* in commercial quantities to molders of apparatus for military and naval end use. Resinox 7934 is suitable for both transfer and compression molding.

For full details write, wire or phone: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield 2, Massachusetts.

The broad and versatile family of Monsanto Plastics includes: Lustron polystyrenes • Cerex heat resistant thermoplastics • Vinyl acetals Nitron cellulose nitrates • Fibestos cellulose acetates • Resinox phenolics • Thalid for impression molding • Resimene melamines. Forms in which they are supplied include: Sheets • Rods • Tubes Molding Compounds • Industrial Resins • Coating Compounds • Vuepak rigid, transparent packaging materials.

MONSANTO
PLASTICS
SERVING INDUSTRY...WHICH SERVES MANKIND



Upsetting AUTOMOTIVE PARTS

SPEEDS PRODUCTION

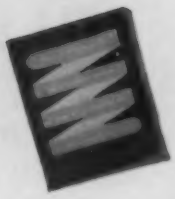
CUTS COSTS

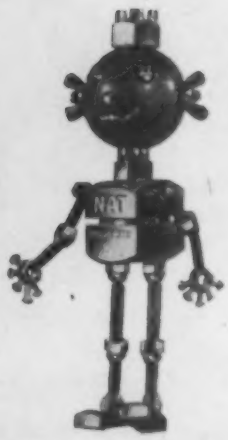
Here are three special parts used in large quantities (two of them run into millions) by a large manufacturer of automotive equipment. They have both war and peacetime application.

They were originally made milled from bar. When sufficient production could not be obtained by that method, the problem was put up to *National*. We developed an upsetting procedure that met the need for *volume production* and also resulted in substantial *cost reductions*.

You may want to look into the possibilities of saving time and money on fasteners, for present needs or future. Or you may have a problem of fastener improvement on which our engineers can help you as they have many other manufacturers.

Chances are you'll be surprised at what can be done.





Send for a copy of this case history booklet describing briefly, with diagrams, 15 typical instances of time, materials and money saved. Ask for the "Savings" booklet.

National
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PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND 4, O.

MODERN PLASTICS

MARCH 1945 VOLUME 22 NUMBER 7

★ ★ ★

PROPAGANDA . . . a threat or a boost

LIKE other new "wonder" industries such as electronics and television which stir the imagination of consumer and manufacturer alike, plastics have begun to suffer from an overdose of sensational eloquence. Too much has been said by too many and the time has come to halt the panegyrics, rationalize the evidence, clarify the atmosphere of critical misunderstanding and cite both fact and fiction.

The world conflict which brought widespread recognition for the remarkable achievements of plastics in the production of war matériel and essential industrial needs, has made such raids upon plastic supplies that there has been little available for civilian use. The pressure brought to bear upon the plastics supplier by the insistent merchandiser has sometimes forced him to resort to makeshifts in design and material and to release only partially tested products and processes. Unfortunately, a few unscrupulous producers have taken advantage of the situation to flood the market with totally unsuitable applications which have boomeranged back against the entire industry.

Failures have been publicly denounced without analyses of their causes, without thorough examination of the facts. Pessimistic prophecies, scathing accusations and hasty condemnations have emanated from even the usually sympathetic friends of plastics.

It is of vital importance that the plastics industry study these charges and plan its program of correction. The attacks come from a variety of sources, but the greatest damage has been done by the get-rich quick hitch-hiker on the plastics bandwagon whose cheap samples have done much to disillusion the public with regard to plastic products.

Then there is the traditional conservative attitude toward progress and "modern" invention. For example, Mr. M. McGraw, president of the McGraw Electric Co., asserted recently at a Chicago meeting of the Investment Analysts Club that plastics were "hazardous" for electric appliances because they were "dimensionally unstable" in the changing temperatures encountered in nearly all electrical devices. He stated that although plastics were now in general use, he could see nothing new in the field to get excited about and thought it unlikely that there would be any increased trend in the use of plastics.

Not only is Mr. McGraw pessimistic but he has shut his eyes to important new developments in plastics materials such as silicones, polyethylene, styrene co-

polymers and the low-pressure resins which are certain to affect a large part of the electrical field. And he ignores the long-established record of thermo-setting plastics in the electrical field which becomes more secure with each new plastics application. Informed engineers can specify plastic materials which will be dimensionally stable where excessive heat will be encountered.

Misconceptions about plastics

When laymen talk of plastics, they are apt to include everything from cocktail stirrers to airplanes in the same general category. This muddled attitude has provided obvious opportunities for flagrant abuses of the prestige of the term "plastics." Typical of the high-pressure promotion and exaggeration are the claims for so-called plastic paints which have adversely affected the legitimate plastic paint manufacturers and merchandisers.

An investigation by the Better Business Bureau of Chicago, last year, revealed that the term "plastic paint" has been loosely applied to practically any kind of paint; that some were good, others bad—depending upon the formula; that no resinous or other substance used in plastic paint justified any unusual claims regarding its length of life as outside house paint. Actually, of course, synthetic resins have been used successfully for years in the formulations of paints, lacquers, varnishes and protective coatings and impart special qualities which make these formulations adaptable for long indoor and outdoor service.

Another popular item with the feature page writers is the "soybean plastic," and any mention of soybeans invariably makes headlines. In a recent editorial in the conservative New York *Sun*, there appeared a comment on the complaints of Springfield, Ill., motorists that dogs were chewing up automobile license tags produced from "a plastic made from soybeans." Upon investigation, MODERN PLASTICS found that the Illinois license plates are made of fibre board coated with nitrocellulose lacquer. No soybeans or any plastic material were used in the 1945 license plates or in the same type plate employed in Illinois during the past three years.

Another field where plastics have suffered because of willful or careless misrepresentation is that of shoes. In a recent booklet published by the U. S. Department of Commerce Field Service, "Retailers' Current Buying Policies in the Philadelphia Tri-State Region," the caustic, critical but undoubtedly honest viewpoint of the retailers is worthy of the attention of both plastics manufacturers and merchandisers. We are reprinting here some of the findings that were reported:

"The use of ersatz materials in the manufacture of shoes has been quite limited. The shortage of heavy hides has brought about the use of leather substitutes for soles. In addition, the growing popularity of women's play shoes has resulted in the use of fabrics and other new materials.

"Customers have not accepted the substitute soled shoes readily. While the quality of some of these shoes has been good, it has frequently been poor. Furthermore, both the customer and the store have been reluctant to accept a type of shoe whose performance has not been proved. Some stores in fact, will not stock substitute soled shoes at all. Others purchase small amounts or are required to accept certain quantities by manufacturers in order to obtain regular leather shoes. When this occurs, the store uses special promotion and may give clerks an additional bonus in order to dispose of these stocks.

"One sales factor of major interest has been the tremendous popularity of women's play shoes. Although introduced before the war. (*Please turn to page 198*)

THE CASE FOR *Synthetic* TEXTILES

OLDEST and second largest of our peacetime industries, the textile industry has resisted any streamlining of its traditional production system. Inroads have been made here and there with the introduction of new processes. The rayon companies, in particular, have established greater integration in their production system, and there has been a trend toward more general purpose equipment—toward looms and spinning frames that produce a larger range of products. But by and large it remains a highly specialized, disintegrated industry characterized by the segregation of each step in the manufacture from the fiber to the finished textile. As pointed out in the initial article of this series,[1] this is due in part to the fact that each of the textile fibers—cotton, wool, silk, rayon and the synthetic fibers—comes from a wholly different set of producers and in part to the fact that climatic conditions cause wide variations in the price of the agricultural fibers which are to some extent cushioned by an elaborate maze of middlemen—assemblers, brokers, converters, spinning mills, weaving mills, dyers and finishers.

From the consumer's point of view the work of the unheralded finisher is perhaps the most valued of all the stages in textile manufacture. What the diamond cutter is to the diamond, he is to the finished cloth; in his hands the word "finishing" takes on new meaning. The cloth that comes into the finishing plant in limp rolls is not recognizable as the crisp bright fabric that leaves the plant—or as anything else in fact. Appropriately called "gray goods" it looks very gray indeed, with a greenish tinge as it falls in a coarse and shapeless mass from the rolls. The finisher not only washes, bleaches and dyes the fabrics in a series of steamy operations; he has a number of other processes to add art to his product. Conventional ones are sizing, singeing, scouring, drying, calendering and others. The textile finishing industry properly regards itself as an art, and each plant has varying formulae and trade secrets to achieve its different effects.

Functional and esthetic finishes

In the nineteenth century the effort of textile engineers was directed largely toward mechanical research and the development of new machines for ginning, carding and spinning. In this century the trend has been increasingly toward physical and chemical research. The older textile finishes were natural materials—starches, gums, natural rosins, glues and tallows—but chemists of our day have added permanent chemical finishes for water repellency, crease-proofing, shrinkage control, color fastness, and resistance to wear, fire, mildew, bacteria and to other conditions detrimental to the performance of the textile. In the development of these new finishes, plastics or resins are increasingly important.

Studies in the field of polymerization have disclosed thousands of organic polymers and synthetic plastic resins capable of application to fabrics. It has been said that plastics can scientifically build into one fiber the traditional advantages of another fiber, and certainly the industry is well on the way to this goal. Plastics can give rayon fibers a resilience akin to wool, and cotton fibers the luster of silk; they can give spun rayons the look of high-priced woolens. Many of the plastic finishes or treatments now being developed are not so much for changing the appearance of the fabric as for improving the physical properties of the fiber, for increasing its tensile strength, for modifying its elasticity and elongation, or for giving other special properties.

Finishes such as those for crease resistance, water repellency and shrinkage control are classified as functional finishes. Others are applied only to improve the feel or "hand" of the fabric and are affected by such qualities as flexibility, resilience and draping qualities. Entirely different finishes can be obtained with the same resin compound, the effect depending largely on the method of application. The same resin compound applied as a surface coating from a solvent or water dispersion can give a lustrous finish, while applied as an impregnation from a water solution it can leave the surface appearance unaffected and give fiber resilience.

Resin finishes can be roughly divided into two categories: those in which the resin penetrates the fiber—becoming an integral part of it and changing its physical characteristics—and those in which the resin lies on top of the fibers—forming a discontinuous film which does not close the pores of the fabric like a continuous film or coating. This division is an arbitrary one which cannot be strictly drawn since in many resin finishes there is a gradation from complete penetration of the fiber to a combination of fiber penetration and surface coating. Most of the changes in the physical properties of the fiber are obtained by applying unpolymerized resins in water solutions and polymerizing them *within* the fiber. The unpolymerized molecules of the resin are small enough to penetrate the fiber, and the application of heat sets and polymerizes them.

Unlike the coating industry, textile finishing plants seldom have the special equipment needed to handle organic solvents which are volatile, flammable and toxic. For the textile finisher the preferred plastic finish is one which is water soluble. The next preferred form is a dispersion of fine resin particles in water, while the third choice (from the aspect of ease in application) is an emulsion of either the water-in-oil or oil-in-water type. Usually, emulsions give better results in in-

This article is Part III of a series on synthetic textiles and deals with plastic finishes for textiles. Part I, which appeared in the September 1944 issue of this magazine, covered the synthetic fibers. Part II, in the February 1945 issue, dealt with synthetic coatings for textiles. Part III covers plastic finishes for textiles.

[1] "The case for synthetic textiles," MODERN PLASTICS, *22*, 91–97, 184–192, (Sept. 1944).

1

KODACHROMES, COURTESY MONSANTO CHEMICAL CO. 2

***1**—Each costume worn by these twins has been subjected to the same suds in the weekly washing. The fabric of the dress at the right has been resin impregnated to prevent shrinkage; the material in the other dress has not. **2**—The finest linens can now be rendered stain-proof. As this laboratory demonstration shows, the application of plain cold water is sufficient to remove an ink stain*

creasing tensile strength and abrasion resistance than water solutions and do not require such high temperatures in curing. A dispersion is a liquid containing solid particles of resin, while an emulsion is a liquid containing drops of another liquid in which resin may be dissolved. An emulsion is actually a dispersion of one liquid in another; tiny drops (or droplets as they are properly called) of one liquid float in another liquid giving the cloudy effect of oil and water shaken together. The plastic or resin is usually dissolved in the oil phase of the emulsion—in the droplets of an oil-in-water emulsion and in the continuous phase of a water-in-oil emulsion.

Ureas and melamines can be prepared in either water-soluble or water-insoluble form, and most of the ureas and melamines used for creaseproofing, for shrinkage stabilization, for wool shrinkage and for chintz finishes are applied as water solutions. In ureas and melamines of the emulsion type, the molecules are large and already polymerized; hence they could not be used for such finishes as wool shrinkage and crease resistance which depend on polymerization of resin molecules inside the fiber.

Plastic finishes for Army equipment

Although the Army's use of fabric finishes was not on such a scale as to necessitate the conversion which took place in the coating industry, yet its extensive use of treated fabrics profoundly influenced research in these new finishes and caused the establishment of rigid specifications and testing laboratories in individual plants just as in the coating industry. Of all the military uses, much the largest volume of resin-treated fabrics went into tentage, into billions of yards of flameproof, waterproof (or water-repellent) and mildewproof cotton duck or canvas. The almost insatiable military demands for tents, kit bags, paulins and other equipment are still occasioning a civilian shortage of duck despite the enormous production. All military tarpaulins and tentage have a resinous compound (resin, proofing agents and pigment) content varying from 35 to 65 percent by weight of the base fabric. This gives them their color and makes them mildewproof, waterproof and flameproof. The function of the resin is to bind on the pigments and proofing agents. Various resins have been used for binders—polyvinyl chloride, ethyl cellulose, modified alkyds, chlorinated paraffins, phenolics and solvent soluble ureas or melamines—and various processes for applying them, but in all the processes the resin is largely deposited on the surface of the fibers.

In military clothing, the chief uses of finishes were for mildewproofing and water repellency. Mildewproofing is essential in the South Pacific where untreated shoes fall apart in a few days and where even mildewproof clothes have fallen apart for lack of mildewproof thread. However, the mildewproofing agents are not resins and do not come into our survey.

Water-repellent clothing for the armies of the world

Though an army may move on its stomach, comfort in clothes and equipment is a major asset to morale and efficiency. Of all the finishes, water repellency contributes most to the comfort of the wearer and, as it is also important in giving protection from the cold, it has been used extensively by all the armies of the world. Our Army and Navy have used an endless quantity of water-*repellent* as well as water*proof* finishes on clothing and equipment. We should perhaps distinguish here between "waterproof," "water repellent" and "water resistant" as there is still some confusion in the accepted definitions of the words. Waterproof fabrics are those in which the pores or the interstices of the fabric are sealed with a continuous surface coating or film, usually of rubber, resins or modified oils. These fabrics, in the language of the textile world, do not "breathe," i.e., they do not permit the passage of air or water vapor through their

pores, and they are, therefore, clammy and uncomfortable to wear. They have the offsetting advantage of being absolutely proof against wind and water. "Water resistant" and "water repellent" are used almost interchangeably to classify fabrics treated to resist water penetration but in which the pores of the fabric remain open. By their very nature as porous materials, water-repellent fabrics are not *absolutely* proof against water, but they have the advantage of allowing the passage of air and water vapor. Thus perspiration is allowed to evaporate through the fabric. Waterproofing is done in a coating or proofing plant, while repellency and other treatments are done by the finisher.

A further distinction to be made in water-repellent finishes is the distinction between "durable," "non-durable" and "semi-durable" finishes. Originally called "permanent" and "non-permanent" finishes by many producers, the Army has changed the terminology to "durable" and "non-durable" finishes since no finish is retained in full strength throughout repeated launderings and cleanings. A much-washed fabric retains some portion but not all of its "durable" chemical or resin treatment. As to what constitutes durability in a finish, opinion varies. For prewar consumer goods the standard for durability varied from six to twelve launderings, but military requirements have raised these standards. In general the criterion is a finish that will last the *useful* life of the garment. According to the type that is used, some repellents are damaged by laundering and some by dry cleaning—particularly the dry cleaning soap used for perspiration stains. A non-durable finish lasts only until the first laundering or cleaning, while a semi-durable finish withstands two or three launderings or dry cleanings.

There are several types of durable water repellents. In the Army the chief use has been of two similar long-chain pyridinium compounds. Neither is a plastic, though both are cured in a manner similar to resins. The Quartermaster Corps does not specify any treatment as such, but only specifies that the treatments shall meet certain tests, such as durability to cleaning processes, tensile and tear strength, that it shall not promote mold growth or cause dermatitis, and that it shall be capable of retreatment with another repellent after washing.

The Army has also approved two durable resin water repellents, and other new ones are being tested. The principle of the resin repellents is that the resin acts as a physical binder or cement to bind on a repellent material (such as waxes, oils, stearates or fats) which would otherwise not adhere to the fabric in cleaning. The repellent agent deposits a surface coating, but does not impregnate the fibers. Resins most frequently used as binders are ureas and melamines, though alkyds may also be used. Two newer treatments employ acrylates. Acrylates used for water repellency are polymerized resins which are usually applied from emulsions. Another new repellent which is still in the experimental stage is based on silicone.

In the designing of water-repellent fabrics our Army textile engineers have followed principles of fabric construction which were long known and first stated by Pearson in 1924, but which have been consistently ignored in the designing of consumer sport clothes and cold-weather wear. The mere fact that a fabric has been well treated with a satisfactory water repellent does not mean that it will keep out rain, as many a drenched golf and ski jacket will testify. Water repellence depends not only on the agent used but also on the pressure of the water to which the fabric is subjected and on the construction of the fabric. In fabric construction, thickness and size and shape of the pores are to be considered. A finely woven high thread count fabric with small pores naturally permits less water to pass through. Thickness of fabric is important because water penetration depends on two kinds of pressure—impact pressure such as the beating of raindrops, and static pressure. A thick fabric offers more resistance to impact pressure. A fourth property—resistance to the passage of air—must also be considered if the fabric is intended to be wind resistant or repellent. However, air resistance and water resistance are two distinct properties since, unlike water resistance, air resistance remains unaffected by any surface tension.

The principle of all water-repellent agents is that they in-

COLOR PLATE, COURTESY CYRUS CLARK CO., INC.

3—*The gay, cool appearance of chintz has made it a perennial favorite with both the decorator and the housewife. Resin treatments have been developed that create a permanent glaze on the chintz which will not wash off*

4

5

ROSALIND CHARLES, COURTESY RIVERSIDE AND DAN RIVER COTTON MILLS INC.

crease the surface or interfacial tension between the water and the treated fibers of the textile. The classical example of high surface tension is mercury, which though a liquid, holds together with such tension that it will not wet anything. Similarly, one can carry water in a sieve if the wires are treated with a water repellent which has high surface tension against water. The same principle in reverse was illustrated by a famous salesman who carried a duck swimming in a tub of water to sell a wetting agent. To decrease surface tension he added the wetting agent to the water, and the duck sank.

In studies of water repellency for military clothes, textile engineers established a concomitant principle—the layering of fabrics. In experiments for his Antarctic expedition several years ago Admiral Byrd had found that one or two layers of wool covered with an outer layer of closely woven, medium-weight cotton treated to be water repellent was very much warmer than the old cumbersome clothes of many layers of wool and fur. The Army now uses similar layering for its cold-weather clothing and the Navy for winter sea clothing. Layering is based on the principle that layers of entrapped air pockets give excellent insulation and provide the lightest and most efficient protection. Air insulation is largely responsible for the warmth of a wool fabric. The fact that the wool fibers do not lie flat in the yarn like rayon but twist in various directions with a wiry resilience that encloses large air spaces, contributes to making a wool fabric warmer than any other. The depth of nap or "loft" of a wool blanket (as the mesh of interlocking fibers on its surface is called) gives it much of its warmth. Although cotton and rayon blankets can be woven with similar air spaces and nap, the difficulty has been that, in a short time, they mat down and lose their air spaces. One of the new resin treatments still in the experimental stage gives rayon fibers resiliency so that insulation is permanently maintained.

In water repellency it was found that penetration of a water spray was dependent on a supporting layer of lining fabric and on the resilience and nap of this lining. A mesh of interlocking fibers offers resistance to water penetration. In one test a single thickness of water-repellent fabric failed in less than a minute when subjected to a synthetic rainstorm. When the same rainstorm was applied to two thicknesses of the water-repellent fabric, failure started in 4 minutes. However, when a single thickness of the water-repellent fabric was combined with a single thickness of lightweight resilient napped cotton flannel, this combination resisted the synthetic rainstorm for 60 minutes. The use of resilient linings such as loosely woven napped fabrics rather than thin, non-resilient fabrics, then, greatly increases water repellency.

It is interesting to find that our enemies, the Germans and the Japanese, hard pressed as they are for wool and cotton, have made extensive use of the layer and insulation principles in fabric construction, using large amounts of rayon staple, which best simulates the natural fibers. In anticipation of the war and a shortage of natural textile fibers, Germany and Japan sponsored a huge rayon industry.[2] Between 1939 and 1942 world rayon production increased more than 50 percent with German and European production sustaining the largest percentage increases. In 1942 German production had reached 1100 million pounds and Japanese production 700 million pounds while United States' production was 632.6 million pounds.[2] It was apparent that the Germans and Japanese planned to rely largely on rayon staple and, presumably, on new principles of textile construction to eke out their wool supply and outfit their army for the winter.

[2] U. S. Bureau of Foreign and Domestic Commerce. Textile Unit. Foreign production data estimated.

COLOR RENDERING, COURTESY ARIDYE CORP.

***4** and **5**—Spun-rayon lightweight men's suitings such as these are resin treated to make them crease resistant. **6**—In a new printing process, resins are used to bind on coloring. The treatment has been widely used for shirtings, dress goods, draperies*

Yet the first German winter campaign in Russia in the winter of 1941 found the German army woefully underclad[2] and seemed to indicate that it was altogether unprepared for fighting in cold climates. German uniforms were reported[2] as still featuring a standard wool overcoat of good weight, but lacking sufficient nap and loftiness for warmth. To this standard wool overcoat a part wool lining was added for the Russian campaign, consisting of 68 percent reworked wool and 32 percent rayon.

In 1942 the Germans designed a special uniform for their winter campaign. Though an improvement on the previous winter, it was still inferior to the Red Army uniform. The layer principle was employed, and the uniform consisted of parka and trousers with a gray-green outer layer of rayon, an inside layer of white rayon, and an interlining of part wool cloth napped on both sides for loft. The part wool interlining was 38 percent wool, and wool content for the entire uniform was about 15 percent, the rest being rayon. No wind- or water-repellent treatment was used on the uniform, but in an effort to make it repellent the rayon fabrics were comparatively thick and heavy. This resulted in poor insulating qualities. According to Russian reports, heat losses throughout the entire uniform were 1364 calories per hour while losses through the Russian quilted-cotton suit were 800 calories per hour.

Water-repellent finishes which would have greatly improved the warmth of these winter uniforms were conspicuous by their absence. Indeed the lack of finishes—water-repellent and other finishes—is the most remarkable in the whole German textile picture, suggesting many shortages. Our Army uses water-repellent finishes on field jackets and other clothing and on cases for sleeping bags. Of the billions of yards of duck used by our Armed Forces a large percentage of it is treated, as we have seen, to be waterproof, fire retardant and mildewproof for use as tents, kit bags and paulins. On similar equipment in the German forces the only finish reported was a starch finish on kit bags. An interesting side on the planned economy of a military people was the discovery that many German uniforms captured in the African campaign had been patched in the field and in use since 1935.

Japan also has a severe wool shortage, and blankets once containing 30 to 50 percent wool now are woven of rayon with a little added cotton and wool. The Japanese have, however, used some finishes and, of course, they have used quilting and layering for warmth. Layers of quilted cotton or silk waste have been standard "textile engineering" among the Chinese and Japanese for the last few centuries. Traditionally, too, the Chinese have made a practice of using tung oil for waterproofing their cotton coats.

One captured Japanese coat for cold weather was made of cotton face (a good wind-resistant fabric) treated to be water repellent; it had a cotton lining, a linen interlining, a quilted padding of cotton cloth, silk padding and paper. Lining materials included rayon pile, wool pile and rabbit fur. The padding was of silk waste and rice paper quilted between cotton sheeting to make a lightweight padding. Textile manufacture among the Japanese, it would appear, still remains on a more individualistic basis than our own.

Water-repellent finishes in consumer goods

While water-repellent finishes are chiefly important for sport and winter clothes, they also have advantages for ordinary dress fabrics since some of the newer treatments are also stain and crease resistant. A startling demonstration is to see an ink splash rubbed into a delicate dress fabric and washed out under the faucet. Cottons and rayons treated with these new finishes have been stabilized by the treatment so that they shrink very little, if at all.

But it must be remembered that fabric construction is an essential consideration in repellency, and the end use of the fabric is always to be kept in mind. All fabrics do not perform equally. A treated dress fabric is intended to resist water or stain absorption only, while a treated cotton poplin is designed for protection from heavy rain. For such a fabric a low thread count poplin will not be adequate; it must be a closely woven poplin of at least medium weight yarns. The only way to insure well-constructed fabrics for sport and rainwear is by a grading system and by informative labelling which shows the repellency testing of the fabric.

Wool that does not shrink

Second only to warm, dry clothes in the comfort they afford (and many a sore-footed G.I. might put them first) are comfortable socks. To an army, its socks are a constant prob-

[2] *Textile World*, October 1944.

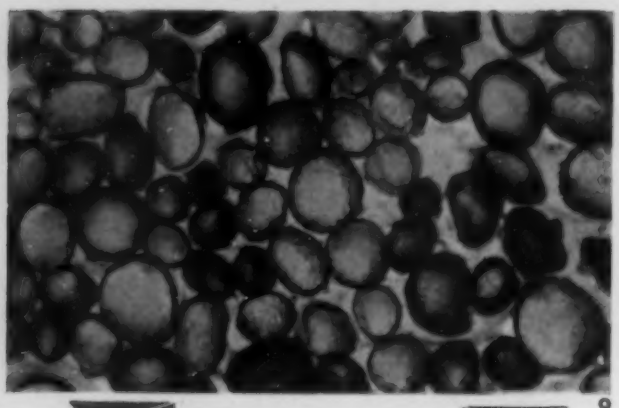
PHOTOS 7-10, COURTESY CALCO CHEMICAL DIVISION, AMERICAN CYANAMID CO.

7

UNTREATED

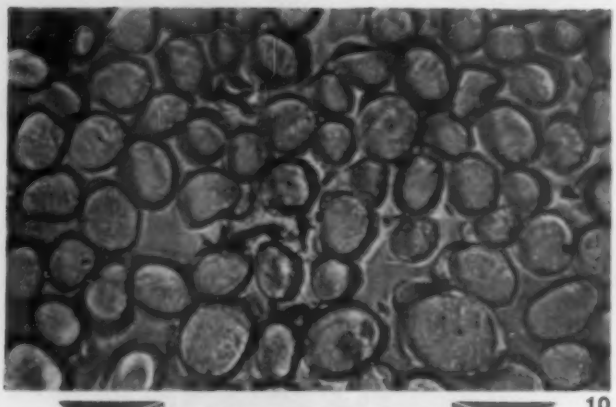
8

TREATED



9

UNTREATED



10

TREATED

In these 4 micro-photographs, dye was used to indicate the effect of resin wool-shrinkage treatment on penetrability of individual wool fibers.* 7*—This cut longitudinal section of untreated fiber was dyed under the microscope to show how easily dye penetrates the cut ends.* 8*—Resin-treated fiber, similarily cut and colored, is more resistant to the penetration of dye.* 9*—Cross section of untreated skein shows how dye penetrates untreated wool fibers.* 10*—Dye has not penetrated the fibers in this cross section of a resin-treated skein dyed as was material described in Fig. 9

lem. Wool socks are essential in winter, but the harsh treatment of the field laundry and of the G.I. who washes them nightly in his helmet causes such shrinkage that untreated socks are uncomfortable and soon unwearable.

Our enemy, the ingenious Japanese, have solved this problem by knitting heelless socks that fit any foot, but at an expense in comfort only to be tolerated by Asiatics. British mills have used non-felting, nonshrinking wools for civilians and for the Armed Services, producing them by a variety of chlorination processes.

Our Quartermaster Corps uses a chlorination process similar to the wet hypochlorites used in England, which closely controls shrinkage on the wool cushion-sole socks worn by our troops. It leaves a residual shrinkage of 6 to 8 percent in the sock. If the shrinkage is removed altogether, the wool fibers lose their resilience and the sock stretches. There are unnumbered chlorination shrinkage treatments, but the one now used by the Quartermaster Corps is a buffered alkaline bath with calcium hypochlorite. By this shrinkage control, the useful life of the sock is prolonged 50 percent.

There are numerous wool shrinkage treatments and the Quartermaster Corps is experimenting with several, among them an enzyme process, the Freney-Lipsom process, and three resin processes. Thus far chlorination has proved to be the most expedient process for socks. Though it needs careful control, it does not require the special curing equipment and high temperatures (300° F.) that most of the resins require and for which the sock knitting mills are unequipped. In the treatment of blankets and other wool goods, chlorination offers problems. The Quartermaster Corps has experimented with a melamine resin treatment on about 2 million blankets, controlling their shrinkage within 5 percent in the warp and 2 percent in the filling. Results of this experiment have not yet been returned from the field. Melamine shrinkage control has also been used by the Army in wool sleeping bags and interlinings.

The theory of wool shrinkage and of the resin treatments is extremely interesting. Though it does not stir the resounding argument caused by the atom, the humble wool fiber excites no less profound and deep-seated dissension among scientists. It is an international controversy, no longer compassed within national boundaries, since certain American chemists have shifted over to English and Australian positions. Positions change rapidly on the international diamond, and one may cheer for a strongly defended theory in one inning, only to hear it shouted down as a ridiculous archaism in the next. Skirting one or two of the strongly held positions in the hope of waking no dormant, scathing lions, we offer the following,

by no means exhaustive, outline of the major positions.

Wool shrinkage is generally thought to be caused largely by felting, i.e., the matting together of the wool fibers after washing or steam treatment. Wool fibers, the fine strands of which the individual yarn is composed, are highly elastic. When wet and warm they move and are pulled out of their original positions. They snap back quickly, but as they snap back into place, they become entangled and interlocked with the other fibers. This is the explanation of the felting action which mats and shrinks the wool.

By some scientists this felting action is explained as a difference in elasticity of the outer and inner layer of the wool fiber. The wool fiber is a tough, elastic tube with a hard outer layer (the cuticle) and a soft inner layer (the cortex). The outer layer, having a different elasticity, tends to snap back faster than the inner portion, causing the fiber to twist and turn like a corkscrew and interlock with other fibers.

Other scientists point to the surface of the wool fiber as the cause of felting. Seen through a microscope the tubular wool fiber has scales on the surface of its hard outer layer. Each scale is barbed somewhat like a fishhook, and like fishhooks the barbs move outward with ease but entangle with other fibers when pulled back. By some this is called the "frictional direction of the fibers," and it is controlled in different ways by the different shrinkage treatments.

Chlorination treatments actually oxidize the fibers, removing some of the scales and making the surface smoother. They soften and to some extent break down the hard outer layer or cuticle, making it more like the soft inner layer. Resin treatments, on the other hand, set the fiber—hardening the soft inner layer and making it more like the outer layer. Some chemists believe that the resin also is deposited as a coating on the surface of the fiber, coating its scales and barbs and setting them in place.

Each of two new melamine shrinkage treatments is an impregnation of the fiber with a resin-forming water solution—a compound which enters the porous interior of the fiber. When heat is applied, the resin polymerizes and sets inside the fiber. These treatments depend entirely on the use of unpolymerized resin, since polymerized molecules are too large to enter the fiber and they form a viscous solution which penetrates poorly. There is a difference of opinion among authorities as to whether *all* of the resin solution is deposited inside the fiber or whether some partially polymerized molecules too large to enter the fiber are deposited on its surface as a coating. Those who hold that no resin is deposited (*Please turn to page 204*)

Resin treatment of wool fibers also prevents felting and maintains the thread structure in woven fabrics after repeated washing. **11**—*As a result of washing, the individual fibers in this untreated fabric have been pulled from the threads and become entangled.* **12**—*After the same amount of laundering, this treated fabric retains its weave and thread structure.* **13**—*This magnification of two yarns of untreated wool shows how fibers have become entangled after washing.* **14**—*Due to the resin treatment, these two yarns, after the same laundering, retain original yarn structure*

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14

1887–1945

Earl F. Lougee—Editor, Author, Educator—loved and sought out the beautiful in all things, in nature and in human life. His philosophy was that of the pioneer, restlessly seeking out the new, unraveling its mysteries, and moving on to new horizons. His personality was that of the giver, always ready to lend a hand, always eager to show the way. These were the virtues he brought to MODERN PLASTICS whose destiny he shaped and guided as Editor from 1935 to 1940. These were the attributes which found expression in his human relationships as Chairman of the Advisory Board of the Plastics Industries Technical Institute when in ill health he retired to California. His pen has left an indelible record of his faith in plastics. We and many others in the industry cherish the memory of his friendship and character.

PHENOLICS IN HYDRAULICS

By E. F. LOUGEE

1 WORLD WIDE PHOTO

This article on the use of plastics in hydraulic systems was received by us only a few days before Mr. Lougee's death. It is, we believe, characteristic of the many well-written and informative articles with which Mr. Lougee supplied this magazine in the four years that intervened between his retirement from the editorship of Modern Plastics because of ill health and his recent death.

A THRILLING sight at any airport is the "take-off" of a huge passenger plane. The loading platform being withdrawn, the plane taxis to a position at the far end of the run, and for a few moments appears to hesitate in indecision before the motors roar. Then it moves down the run, sometimes directly toward you, gaining speed with every foot. Faster and faster it rolls until suddenly its nose lifts into the air and it is off. Then, as it clears the roofs of airport buildings and circles into its path to distant cities, you see its landing gear with huge rubber-tired wheels fold gently and gracefully into the fuselage, out of sight. Belly doors close tight to cover this gear, and remain closed until the ship is ready to land.

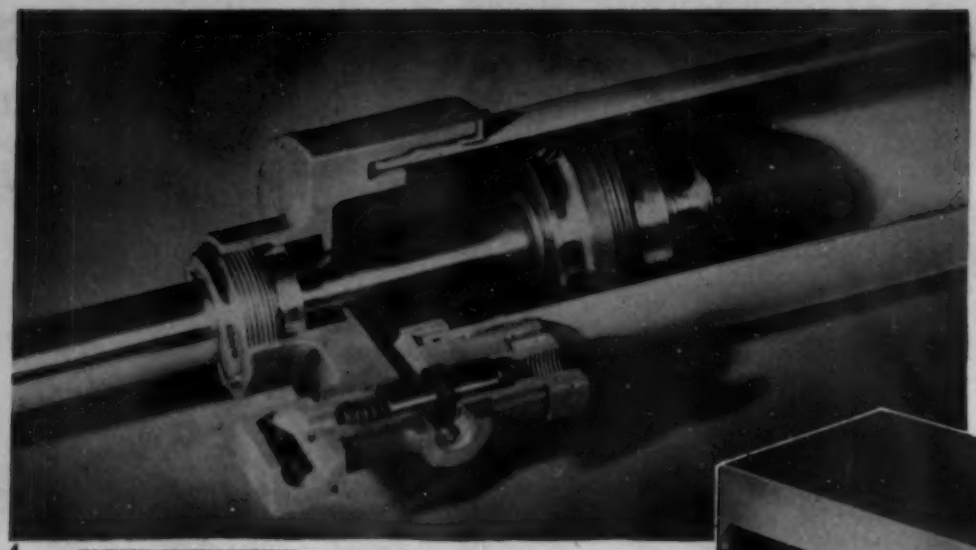
There are three wheels in the main landing gear, weighing from 500 to 1200 lb. each, depending upon the size of the plane, and a nose wheel weighing about 300 pounds. Yet, the gear is moved into landing position or withdrawn for flight simply by pressing a button or lever which actuates a hydraulic valve. Wing-flap controls, bomb-bay doors, tail turrets—in fact, nearly all movable equipment on the control surface on most of our large combat airplanes—operate by the same means. It is therefore apparent that the hydraulic system in modern aircraft is extremely important to the successful performance of the ship. If the hydraulic system fails, the ship fails. If the landing gear jams, it means a crash landing which may cost lives and damage the ship beyond repair, although some pilots with exceptional courage and skill manage to bring their faulty ships to earth in a belly landing with little damage and no loss of life.

Hydraulic failures are rare, however, because the engineering standards employed in the manufacture of hydraulic systems and the care and precision with which they are built leave

PHOTOS, COURTESY [illegible]

1—The Douglas combat transport C-54 is representative of the type of plane which uses phenolic parts in its hydraulic systems. 2—The plastic poppet in this check valve is designed to give exceptional flow characteristics. 3—This check valve, especially designed for use with either oil or air, is produced with a minimum of weight by incorporating a plastic poppet and a resilient seal which employs a plastic retaining sleeve

little to chance. Hydraulic systems, like the motors for aircraft, are seldom built by aircraft manufacturers themselves. It is a business separate and apart from aircraft assembly, but it requires equally high engineering and mechanical skill. Tolerances for both moving and stationary parts are exceedingly close. Valves and poppets must have long life and be able to withstand extreme temperature differentials; they must seat perfectly to prevent leakage throughout their useful life; and packing—the most critical single factor in the hydraulic system—must maintain positive contact with the cylinder walls at all times to prevent low pressure or static



4

ALL PHOTOS COURTESY HYDROPACK

5

4—This hydraulic actuating strut was cut away to show the Nuckles packing and phenolic rings. 5—A hydraulic 4-way selector valve that incorporates phenolic poppets and packing rings

leakage. It must be made of sufficiently stable materials to perform with uniform efficiency under a widely varying range of temperature conditions, yet be flexible enough to confine and control the flow of fluid under all these conditions.

It may be surprising to some to learn that precision-molded phenolic retainer rings, poppets and seats are replacing those formerly made of steel, aluminum and bronze, with considerable savings in cost and weight and no sacrifice in the performance or life of the hydraulic parts. The saving in weight alone recommends their use in aircraft, but it is well known that the introduction of any device in aircraft manufacture which promises to save weight must be predicated upon exhaustive performance tests which prove beyond any possible doubt that no sacrifice in service will result.

This transition to plastics began nearly four years ago when Hydropack, a Los Angeles concern which had been manufacturing hydraulic parts and systems for many years, conceived the idea that their special packing material could be held in place with plastics instead of metal retainers. Scarcity of metals, and skilled men to machine delicate parts to close tolerances, prompted the investigation. As so often happens, it was mostly wishful thinking that started Clarence Pool, head of the concern, on one of the most disappointing trails he had ever followed, yet one of the most promising as this is written.

"None of us knew anything about plastics," as he puts it. "Not one of the men in our shops had ever seen the inside of a plastics molding plant. All we knew was what we had read about plastics, and we thought that if our retainer rings, and some of the complex valve parts, could be molded instead of being machined from metals, our labor situation would be greatly improved."

The next step was to find a molder who would promise tolerances as close as ±0.001 on parts varying in size from 1/8 to 8 in. in diameter. Every molder Mr. Pool approached shook his head and said he wouldn't tackle such a job. Finally in desperation, he persuaded a molder to undertake one piece and agreed to assume the expense of the mold which seemed exorbitant to him. Samples were made and tested but the number of rejects was so great that when orders started coming in, the molder decided he didn't want to continue the job because some of the proposed parts were much more complicated than those he originally turned out.

"So there we were," says Mr. Pool. "We were almost convinced that the tolerances we required were not possible in phenolics. However, we were still faced with a critical manpower situation and decided to undertake the molding ourselves."

Years of experience with metals made the problem of molds fairly simple, but presses—that was something else again. No presses could be purchased at the time, so the company set out to build its own. "We certainly started the hard way," says Mr. Pool, "but we now have 45 presses in operation, varying from 20 ton to 50 and 100 ton, and they give us more economy and precision for short and medium runs, than would larger presses with greater mold capacity."

Phenolic compounds were specially developed which, Mr. Pool says, "are just about the answer to a molder's dream." These compounds were created for this particular application but have since had Navy approval and are available to other molders doing similar work where exceedingly close tolerances are required.

After making retainer rings of molded phenolics, and being able to maintain tolerances of ±0.0025 in the 8-in. size, the company decided to try to overcome the corrosion problem encountered with steel poppets. They took a check valve which had a steel poppet with an inserted steel seat and replaced the poppet with one made of phenolics. A life-test was set up where two valves operated side by side, one with a steel poppet and one with a phenolic poppet, but both having a steel insert seat. During the life of the phenolic poppet they replaced three steel poppets and two steel seats, while the valve with the phenolic poppet still functioned perfectly against the original steel seat.

Convinced that they were on the right track for improving the performance of their hydraulic products, the company

next removed the steel seat and allowed the phenolic poppet to seat directly on the Dural housing. It worked just as well and lasted just as long, and the elimination of the steel seat gave an immediate saving of 65 to 70 cents per valve. The flow characteristics of valves with phenolic poppets have improved from 300 to 500 percent, according to Mr. Pool.

Besides the dollars and cents savings, there is a saving in weight which is vitally important in all aircraft work. While there are only three or four hydraulic valve assemblies in some of the smaller airplanes, there may be seventy-five or eighty in larger ships. With the length of life increased, replacements are less frequent. If a poppet should wear out, it may be replaced, but the company has yet to see a phenolic poppet wear out. Previously, when a poppet failed to seat in the steel insert, both poppet and seat had to be replaced, so that it was usually cheaper to replace the entire valve.

Packing has always been the most critical part of any hydraulic system, and still is for that matter. Recent years have brought increasing improvements however, and this manufacturer of hydraulic parts has made notable contributions by creating what is known as Nuckles chevron packing rings. These rings, having a neoprene base, are designed to bring positive lip pressure on the cylinder walls at all times whether or not there is fluid pressure. The synthetic rubber is not attacked by hydraulic fluids, nor is it affected by heat conditions which run from −65 to +160° F. Being tough and resilient, the rings flex freely under pressure and have unusually long life. The company also makes other types of packing, such as U-cups, all highly resistant to mineral oils, aging and oxidation, a factor essentially important in aircraft hydraulic systems where the packing is continuously subjected to extremes of pressure, temperature and wear.

The combination of synthetic rubber packing, molded phenolic poppets and retainer rings in hydraulic systems, is indicative of the engineering advancement we can expect in plastics after the war. There is little question in the minds of most engineers that plastics have a definitely useful field in mechanical applications where their performance has been proved to be more satisfactory than any other materials that might have been used.

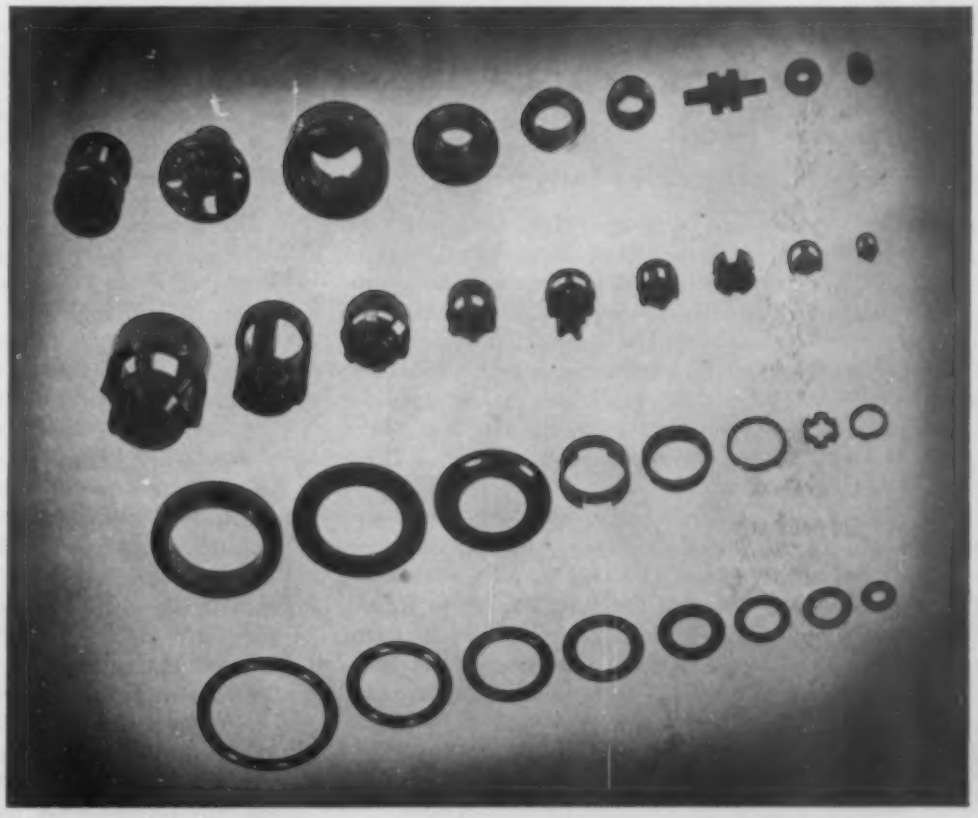
The company sees much greater use of hydraulics in the future than has been apparent in the past. The same principles used to withdraw the heavy landing gear into the belly of a plane and close the doors behind it will be employed to actuate machine tools. Aircraft will develop the use of hydraulics in new applications. Dump trucks, heavy highway equipment, oil-well machinery—in fact, any equipment which requires dependable power to activate heavy and cumbersome operations—will rely more and more upon hydraulics.

Hydraulic stabilizers may become as common in our automobiles in the future as hydraulic brakes are now. They permit American tanks to fire heavy guns while racing across rough battlefields. With this device, American gunners traveling at approximately 15 miles per hour, are able to score better than 70 percent hits over a range of 300 to 1200 yards. Without the stabilizer, the same gunners were unable to score 1 percent hits. It is reasonable to expect that automobiles and railway trains may overcome vertical vibrations and provide smoother rides by adopting these principles.

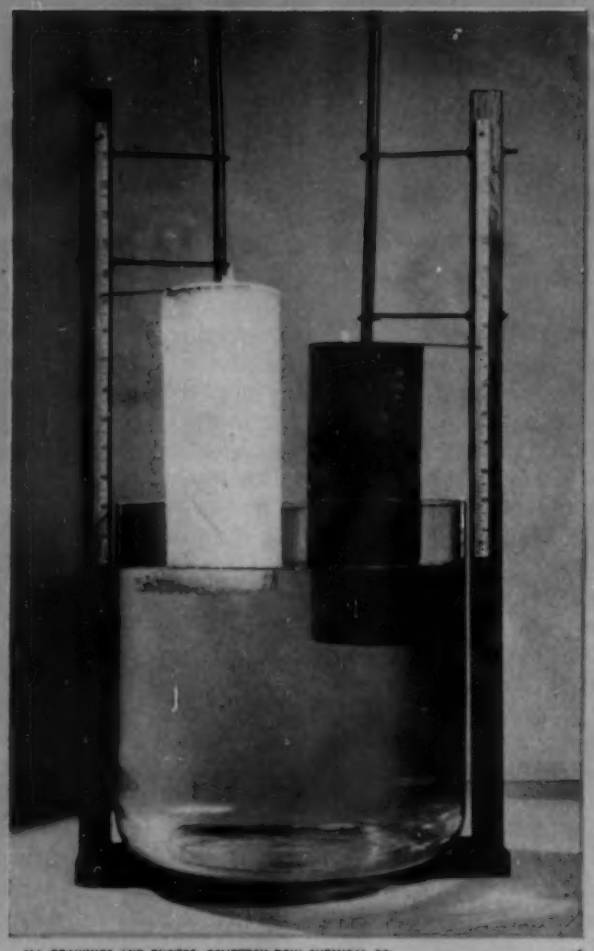
The principles of hydraulics are well established. They are not new to the plastics industry because most of our molding presses are opened and closed by hydraulic valves. The use of molded phenolic retainer rings and poppets in the hydraulic system, however, is worth watching.

Asked if he used phenolic retainer rings in the presses he built, Mr. Pool said, "You bet we do, and if we can ever get ahead of our aircraft orders, we want to make them available to every press manufacturer who would like to use them. Up to the present time, however, we have been able to supply them to only a few aircraft manufacturers who use them in their forming presses; everything else goes into the hydraulic systems of the planes themselves."

Credits—Hydraulic parts molded by Hydropack.



6—A comprehensive group of plastics parts has been developed for use in hydraulic systems. The parts shown here include packing rings, retainer rings, poppets and miscellaneous pieces



ALL DRAWINGS AND PHOTOS, COURTESY DOW CHEMICAL CO.

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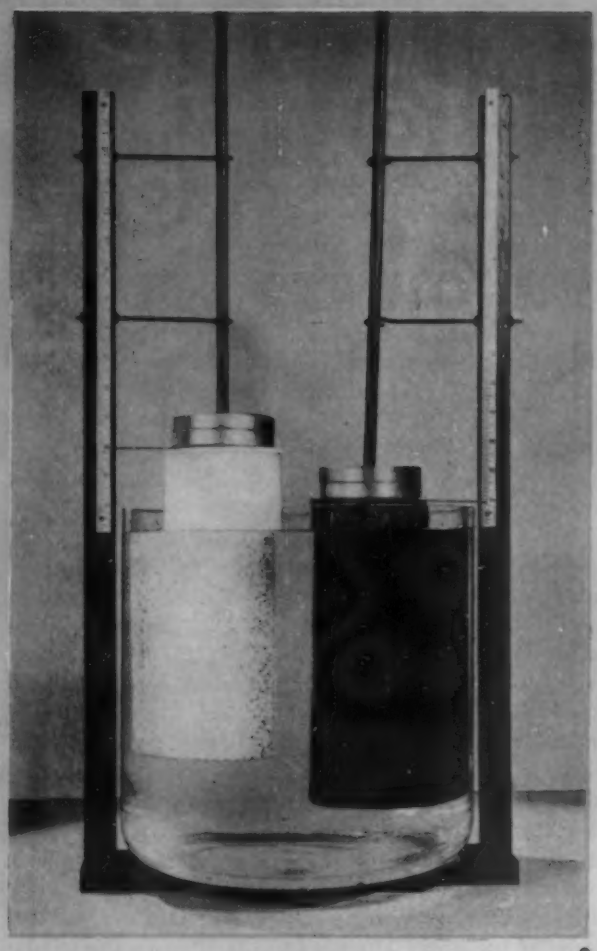

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An E-X-P-A-N-D-E-D polystyrene

by D. W. McCUAIG and O. R. McINTIRE*

AN entirely new field of plastics applications has been opened up due to the unique properties and the ease of handling of a recently developed plastic material—Styrofoam.[1] Made by expanding polystyrene into a non-permeable multicellular mass of very low density, this new material consists of small pockets of air contained in polystyrene cells. Many of the properties of this plastic are derived from the parent material, polystyrene, which has the very low specific gravity of 1.05, is odorless and tasteless as well as being highly resistant to water.

The process of expansion is rather complicated and considerable control is necessary to produce a uniform cell structure and density. While the process permits a variation in cell size and wall thickness which in turn allows for the production of a range of densities, all development at present is concentrated on the production of one density. Therefore, only an expanded polystyrene with a density of approximately $1^1/_2$ to 2 lb. per cu. ft. is today commercially available, although various densities are produced on a small scale.

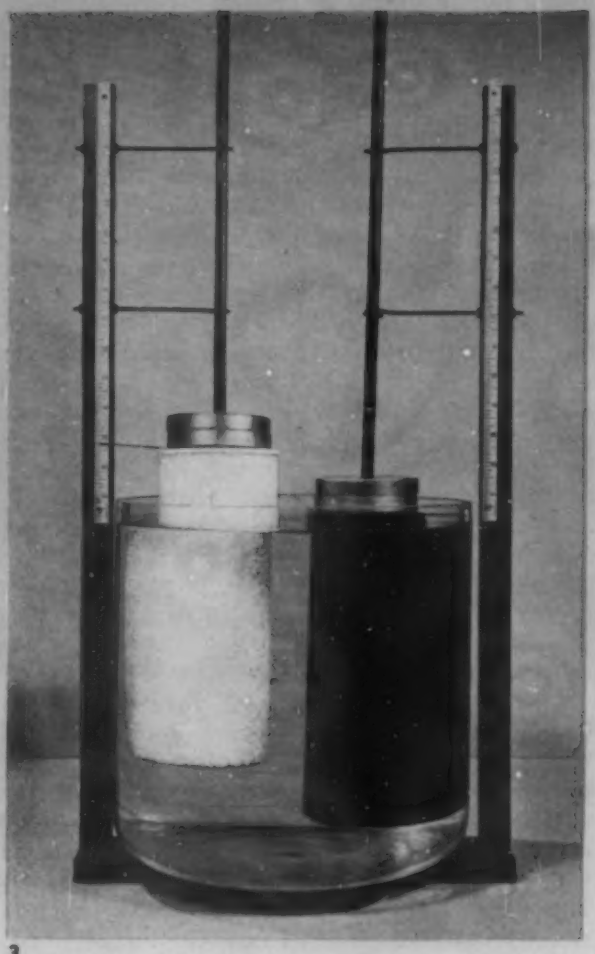
The amount of expansion taking place and the resulting reduction in density is illustrated in Fig. 13 in which an equal weight of expanded polystyrene and polystyrene are compared. The difference in volume of the two pieces is approximately 42 times. For purposes of illustration, the increase in volume is shown in only one direction. The actual expansion takes place in all directions.

Low density is one of the outstanding properties of this new material. Some idea of its low unit weight may be gained by comparing it with cork or balsa wood, both of which are considered as relatively lightweight materials although they are 4 to 10 times heavier than the expanded polystyrene. In spite of its extreme lightness, this plastic has considerable structural strength and, while not to be compared with much heavier structural materials, can be handled without the necessity of special care to prevent damage. That it can support a considerable load without distortion is aptly portrayed in Fig. 11 which shows eight men being supported by two 10-in. square blocks.

The unique character of this new material made it necessary to use modified testing methods. Table I lists its

* Plastics Development Div. and Physical Research Lab., respectively, Dow Chemical Co.

[1] Trade name, Dow Chemical Co.



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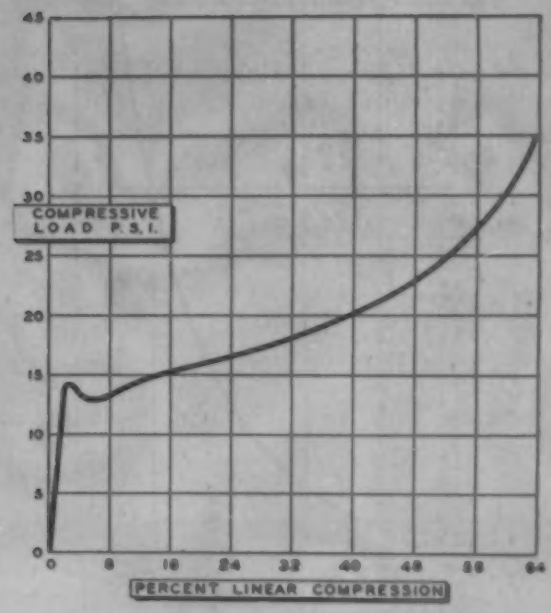

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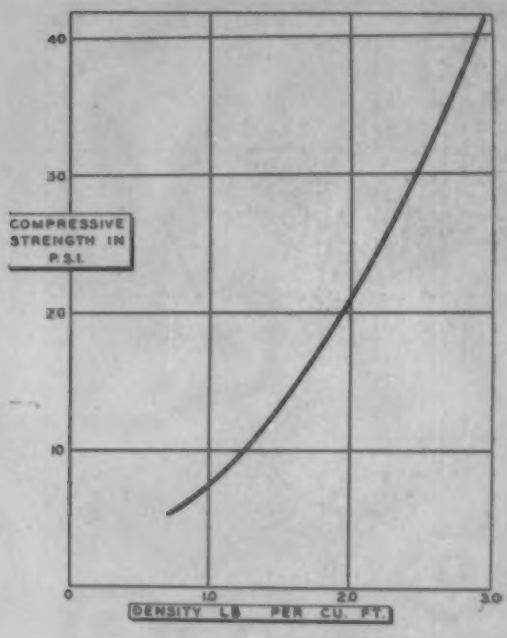

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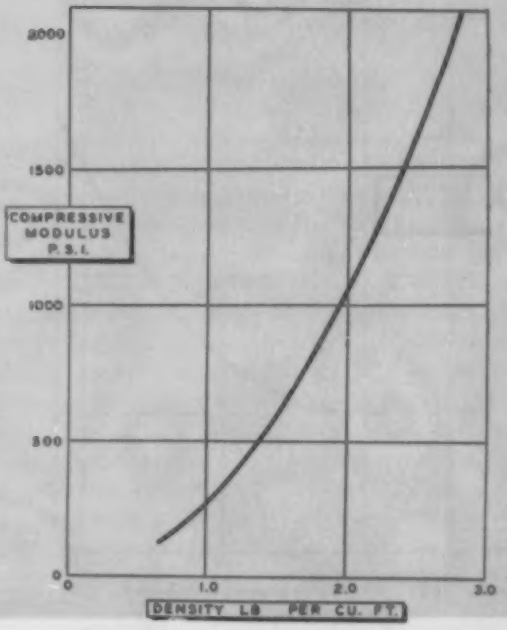

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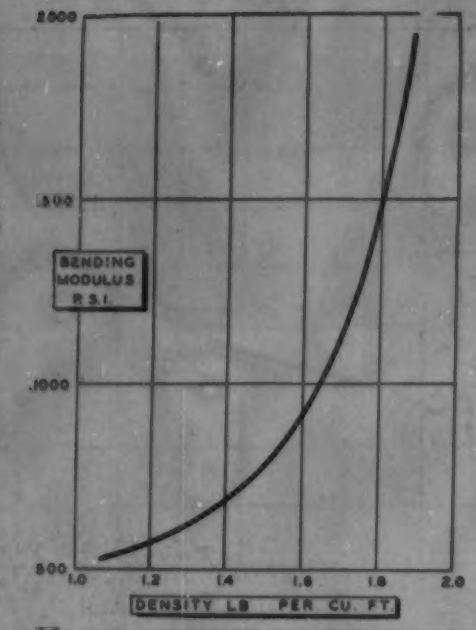
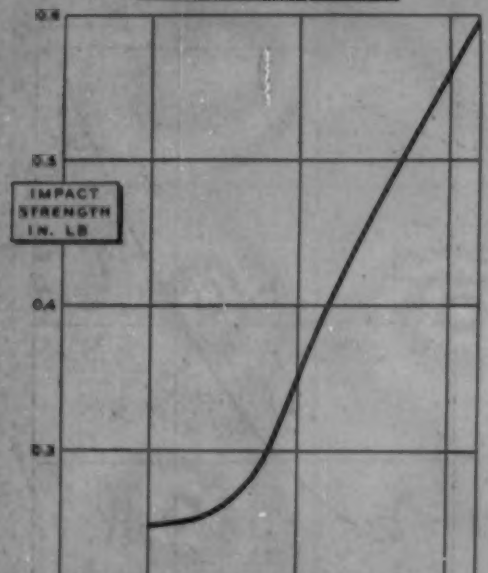
***1**—To illustrate the buoyancy of expanded polystyrene, 10-in. long samples of this new plastic and cork were placed in water with only sufficient force applied to hold them upright. **2**—When an equal amount of weight was added to each sample, they continued to retain about the same relative positions. **3**—After a week's exposure to the conditions shown in Fig. 2, the cork was found to have lost more buoyancy than the expanded polystyrene. **4**—A compressive strength curve for expanded polystyrene. Density 1.5 lb./cu. ft. **5** and **6**—Chart showing relationship between density and physical properties*

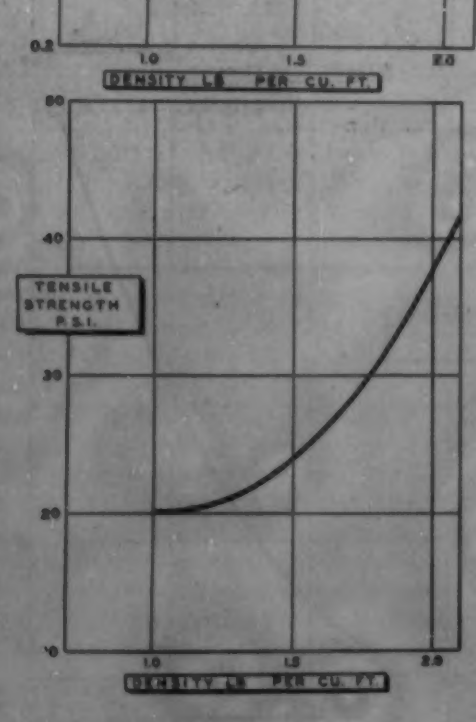
physical properties based on a product having a density of 1 to 2 lb. per cubic foot. In order that a comprehensive evaluation of the table may be made, the methods of obtaining the data are worthy of further discussion. Especially is this true of the compressive strength which can be measured in various ways with great differences in results.

Figure 4 shows a compressive strength curve from which the data in Table I were obtained. The compressive strength is determined as the stress at the yield point. At this yield point, expanded polystyrene has been compressed elastically about 5 percent. The modulus of elasticity in compression is determined from the slope of the curve below the yield point.

Tensile strength is measured using specimens with a reduced cross section of $^3/_4$ by $1^1/_2$ in. with a rate of jaw separa-







7 tion of 3 in. per minute. Bending modulus is calculated from a plot of bending deformation versus load during the bending of a centrally loaded beam 2 by 2 by 12 inches. Impact strength is measured by the Izod method with an unnotched sample having a cross section of $^1/_2$ by $^3/_8$ inch.

Table I gives the properties of the expanded polystyrene which are available at the present time. However, since there is a rather uniform variation in properties with changes in density, Figs. 5 to 9 are of interest. These figures show the relationship between density and physical properties. The physical properties of other densities may be very closely approximated by extrapolation of these curves.

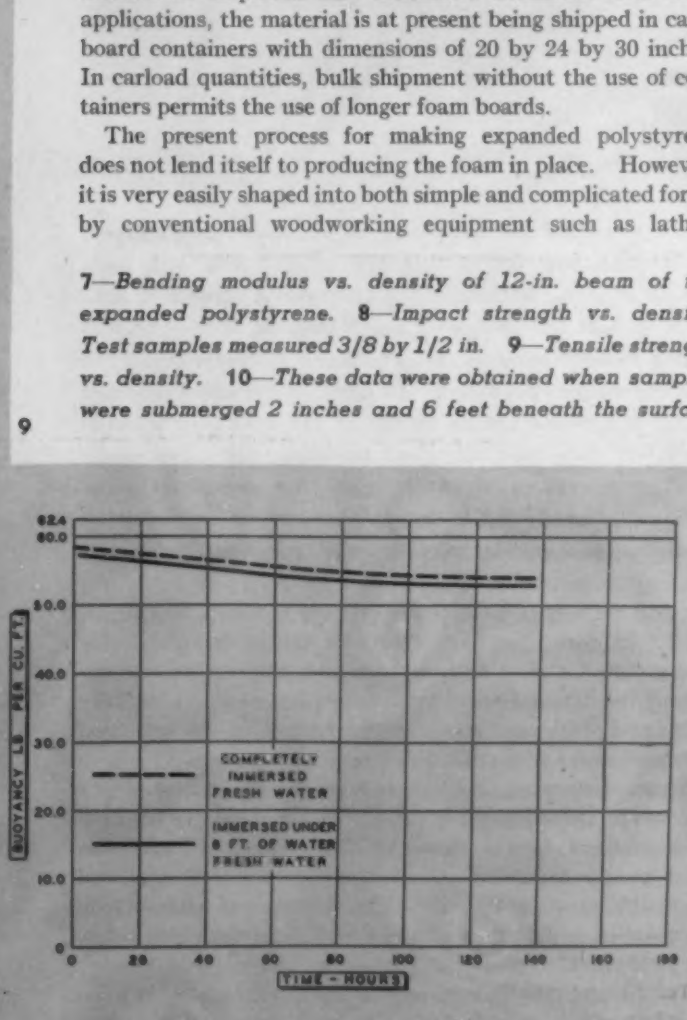
This new material is highly resistant to mold growth, rot and decay. It is not affected adversely by weather exposure and like its parent material, polystyrene, loses none of its strength characteristics at low temperatures. As it is made of a thermoplastic material, its use at elevated temperatures is limited. Tests indicate that it may be safely used over extended periods of time at temperatures as high as 170° F.

Expanded polystyrene is flammable and can be made to burn under favorable conditions. Its rate of burning is slow and its flame is easily extinguished. Attempts to ignite the material using methods other than an open flame have failed, and it is believed necessary to apply a flame directly to the material before combustion will take place.

In order to expedite the present production, the material is furnished only in assortments of sizes consisting primarily of boards 2 or 3 in. thick, of varying lengths and widths. The maximum width is 12 in. and the length is controlled by the method of shipment and containers available. For most applications, the material is at present being shipped in cardboard containers with dimensions of 20 by 24 by 30 inches. In carload quantities, bulk shipment without the use of containers permits the use of longer foam boards.

The present process for making expanded polystyrene does not lend itself to producing the foam in place. However, it is very easily shaped into both simple and complicated forms by conventional woodworking equipment such as lathes,

***7**—Bending modulus vs. density of 12-in. beam of the expanded polystyrene.* **8**—*Impact strength vs. density. Test samples measured 3/8 by 1/2 in.* **9**—*Tensile strength vs. density.* **10**—*These data were obtained when samples were submerged 2 inches and 6 feet beneath the surface*



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11—The strength of this expanded polystyrene is evidenced by the way in which two 10-in. square blocks can support 8 men. **12**—*A kitchen knife was used to carve this figure from a single piece of the new plastic. Since only the colorless, white expanded polystyrene was available, the figure was subsequently painted*

shapers, planers, saws and drills. For example, the Santa Claus in Fig. 12 was carved from a single piece of Styrofoam with a kitchen knife. It was made from colorless, white expanded polystyrene, the only type available at present. The figure was painted to provide the desired colors. This new material can be produced in a wide variety of colors but these types will not be available until the postwar period.

In applications where more than one piece is necessary, the material may be bonded successfully to itself or to wood, metal and various other materials. Some of the most successful results have been obtained by using cold-setting resinous glues such as casein, phenol-formaldehyde and urea-formaldehyde. Adhesives containing solvents will attack the expanded polystyrene and should not be used without a thorough check of their effect. Solvents may be used to bond the material to itself, but again great care must be taken to prevent the solvent from attacking this plastic to too high a degree. In all cases better adherence is obtained if the surface of the material to be bonded to the expanded polystyrene is rough rather than smooth.

The above properties, plus the fact that the completely independent cell structure of this plastic provides a very good water-vapor barrier, has led to a complete investigation of the material's suitability for buoyancy applications. Extended tests have proved that it has an excellent initial buoyancy and retains its buoyancy to a high degree over long periods of time. The open cells on the surface of the material fill with water, making it necessary to measure the buoyancy during actual submersion in order to obtain accurate results. Figure 10 illustrates the data obtained for submersion 2 in. beneath the surface and 6 ft. beneath the surface. The test

TABLE I.—PROPERTIES OF STYROFOAM

Density, lb./cu. ft.	1.0–2.0
Compressive strength, p.s.i.	5–20
Modulus of compression, p.s.i.	270–1100
Modulus of elasticity in bending, p.s.i.	520–2000
Tensile strength, p.s.i.	20–40
Impact strength, in.-lb. ($^3/_8$ by $^1/_2$-in. specimen)	0.3–0.6

under 6 ft. of water may be considered as an accelerated test as this depth is the approximate equivalent of 3 p.s.i. hydraulic pressure. Any weakness in cell structure would become apparent at this pressure. The data show that the expanded polystyrene has an initial buoyancy of 58 lb. per cu ft. under total submersion and drops off slightly, reaching equilibrium at approximately 80 hr. of submersion. The initial loss is probably due to a more complete filling of the surface cells which have been broken in forming the material to the proper shape. The curve of data obtained under 6 ft. submersion parallels rather closely that obtained when the sample was just under the surface.

To further illustrate the buoyancy of this plastic, Figs. 1, 2 and 3 compare expanded polystyrene and cork of equal volume. The cork tested is similar to that used for flotation applications. In Fig. 1 the ma- (*Please turn to page 202*)

Smoking them out

by V. T. GRIFFITHS*

CANADIAN ARMY PHOTOS

Two Canadian soldiers demonstrate the effectiveness of No. 77 smoke grenades, highly rated for the "cover from view" they afford troops. Closeup at right shows molded plastic cover and mechanism holder

IN a war where excellence of materials and manufacture is a prerequisite for all equipment, mention in dispatches and citations of specific examples of outstanding performance is unusual. This honor came recently to No. 77, a light, hand-percussion smoke grenade with a plastic mechanism holder and safety cap, used by Canadian assault troops in France, Belgium and Italy. Its provision of a lifeguarding cover gained for it a prominent place in the citation accompanying Major Jack K. Mahony's award of the Victoria Cross for outstanding service.

"At one stage," reads part of the citation covering the highest attainable award in the British Empire, "a section (on the Melfa River in Italy) was pinned down in the open by accurate and intense enemy machine-gun fire. Major Mahony crawled forward to their position and, by throwing No. 77 smoke grenades, succeeded in extricating the section from its position with the loss of only one man."

Again, a Canadian brigade commander reporting on grenades from Italy said: "This No. 77 is excellent in street fighting and for clearing houses and farms. The German soldier is very scared of it." The chief characteristics which give the enemy cause for alarm, are the grenade's light weight (12 oz.) which permits it to be carried in packs and released by hand, its instantaneous explosion smoke screen, and its white phosphorous particles which ignite everything they touch.

In order to make the smoke screen instantaneous, the grenade is exploded by a detonator. The body, which is filled with phosphorous, consists of a tinned plate casing with a screw-on lid. In the center of the lid is a plastic fuze shell or mechanism holder covered by a plastic screw-on safety cap and containing a ball, striker and creep spring, and another holder with a cap. A safety bolt passes through a hole in the fuze shell and another in the striker, thus keeping the striker in position. To this bolt is attached a length of tape, which has a lead weight on the outer end.

When a patrol or assault section needs close cover in a hurry, the section commander shouts "Smoke!" Whereupon each soldier carrying No. 77's grabs one, removes the safety cap, holding the tape in position with his fingers, and hurls it where directed. As he throws the grenade, the weight

* Plastics Engineer, Peterboro Works, Canadian General Electric Co., Ltd.

at the end of the tape causes the tape to unwind, thereby withdrawing the safety bolt. On impact, the striker overcomes the creep spring and fires the cap which sets off the detonation—exploding the grenade. Immediately on contact with air the white phosphorous ignites and gives off dense smoke for about half a minute. By discharging No. 77's at intervals, the smoke screen can be increased in size and duration.

The fuze for the No. 77 smoke grenade is known as the No. 247 and is a justly famous part of this saver of heroes. Only the fuze shell, which includes three parts—body, cup and safety cover—is of plastic. The body has three threads, all molded. First there is an internal thread into which the threaded cup is screwed; next there is an external 4-lead thread which screws into the internal 4-lead thread of the safety cover just tightly enough so that it can be removed with a quick one-quarter turn; third, there is an external semi-round thread which holds the fuze assembly snugly in the metal grenade can.

The No. 247 fuze for the No. 77 smoke grenade was first made in Britain. Therefore, when orders were placed in Canada, material specifications were issued in accordance with what British molders had found to be suitable for the application. All materials used are inspected for these specifications by the Inspection Board of the United Kingdom and Canada at the plant of the supplier, and are shipped as approved to the molders. A medium-impact, cotton-flock-filled phenolic proved suitable for the body. However, the chemical requirements were extremely rigid and, though several compounds were submitted for approval, a phenolic material was selected which had previously been approved for part of a plastics hand grenade which used the same fuze. The material for the screw cup, wood-flour filled but with almost as rigid chemical specifications, required a different grade of compound. In molding the safety cover a general-purpose phenolic material has proved satisfactory.

The body of the fuze is molded in 4-cavity transfer molds, six of which are used to produce 40,000 units per week. These split molds have a rectangular pot area with two sprues, each being gated to two cavities. The upper and lower halves form the exterior of the fuze body part, including the semi-round thread. After the molding operation is completed, the halves part to permit the removal of the threaded cavities which form the exterior 4-lead thread. These cavities are attached to a bar which facilitates their removal, and which holds in place the threaded plugs that form the internal contours of the part. For the cover, three 8-cavity compression molds are used. Two 10-cavity compression molds are used for the cup. Working surfaces of all these molds were chrome plated. The value of this plating is indicated by the fact that the cavities show almost no wear after a full year's operation during which one and a half million parts were produced with a minimum of rejects.

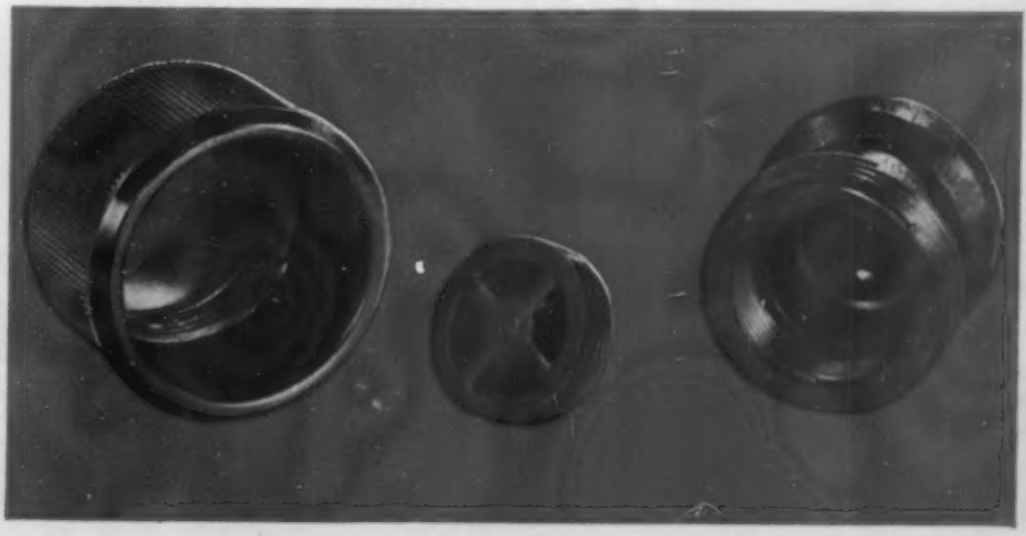
Dimensional tolerances on the body of the fuze are very close. However, except for a few minor mold adjustments that were necessary at the outset of production, no difficulties have been experienced in maintaining dimensions within the specified tolerances, and the company has had only 1 to 2 percent rejects for incorrect dimensions. However, in order to bring the over-all dimensions within the tolerances and give stability to the threads, it was found necessary, after molding, to bake the bodies for 3 hr. at 150° C. This procedure also helped to bring some of the chemical requirements into line with specifications. A $1^1/_2$-hr. baking period at 150° C. proved sufficient for the screw caps; no baking was required on the covers.

For the molding of the body, the pot is charged with 174 gr. of soft-flow phenolic material which has been formed into pellets. No preheat is necessary. The pressure on the pot is 67 ton or 4.8 ton per square inch. Pot and plunger temperature are 300° C.; cavity temperature 310° C. Cure time is 3 minutes. After molding, the mold is opened and the bar to which the fuze bodies are attached, removed. The plugs forming the internal contours of the body are unscrewed from the part by means of an air gun. Then the bar is unscrewed from the threaded cavities and, finally, the part unscrewed from the 4-lead thread in the bar. The hot bar is immediately placed in another mold obviating any need for preheating and reducing the number of bars and punches which are normally required.

The cover and cup molds are loaded with pellets of the phenolic material using a loading board. The covers are removed by hand from the 4-lead male thread on the mold punches. In the case of the standard thread on the screw cup, an air gun is used to remove this plastic part from the female thread in the mold cavity.

As a "safety weapon" in war, the No. 77 smoke grenade is in a class by itself. The No. 247 fuze which activates the grenade represents a quality of plastics molding of which the Canadian plastics industry can be proud, and gives evidence of the future achievements which can be expected.

Credits—Materials: Body, Durez. Screw cap, Resinox. Safety cover, Durite. Molded by Canadian General Electric Co., Ltd.



Only the shell of the fuze for the No. 77 smoke grenade is made of plastic. It comprises a molded body, cup and safety cover

New brake linings for jeeps

EVEN in the dead of winter there are days when the sun transforms the dirt roads on the Eastern Front into mud holes. Yet messages must go through and key military personnel be transferred from one sector to another. Regardless of weather or road conditions, the motorized equipment of every branch of our Army must operate at peak efficiency.

So that the all-purpose jeep will be capable of stopping at a second's notice even after a hard pull through miles of mud or after a break-neck cross-country ride over rough ground, at least 500,000 of these vehicles have been equipped with a new type of molded brake lining. Standard equipment on all the jeeps produced by Willys-Overland and Ford Motor Co. and on the military vehicles of at least 61 other manufacturers, these linings are the result of 12 years of research by the engineers of the Marshall-Eclipse Division of Bendix Aviation Corp.

Basically the new linings consist of a composition of friction materials held in a phenolic resin matrix. The use of the phenolic resin to replace rubber as a composition base was found to impart to the new linings a resistance to braking temperatures considerably in excess of any temperatures developed by peak emergency braking loads. Standard tests show that the linings are capable of withstanding heat ranging from 100 to 1000° F. flash temperature although heat generated in a brake drum under even such strenuous operating conditions as are experienced by combat jeeps seldom reaches above 400° F. flash temperature. Coupled with this resistance to extreme brake temperature, the new linings possess remarkable compressive, impact and shear strength.

When the idea of developing a new brake lining to meet the stringent requirements of military vehicles was first conceived, the engineers of this company joined with technicians of the Bendix Products Division, a large-scale manufacturer of brakes, in the testing of hundreds of different plastics compounds. Unable to find a material that possessed exactly the qualities of heat resistance and durability that seemed desirable for this application, chemists evolved a new plastic of the phenolic type, based on imported tung oil.

Domestic tung oil does not react in the brake-lining manufacturing process which involves isomerization, polymerization, esterification, inter-polymerization and, finally, condensation to the infusible stage. Since some of these reactions are allowed to occur in the brake lining compound during processing, an entirely new method of plastic fabrication had to be developed. This process combines, in various stages, compression molding, injection molding, cold molding and extrusion.

After the phenolic resin binder reaches the first stage in its reaction, it is discharged from the mixer in dry batch form. Then, a little at a time, the material is rammed into a hydraulic extruding unit for compacting. As a result of this treatment and the heat of constant impact, the binder reacts to a second stage. The (*Please turn to page 204*)

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1—A further improvement in the amazing mechanism of the jeep is a molded brake lining which enables it to stop at a second's notice. The linings are shown being inserted into multiple spindle drill presses which drill eight holes in the part simultaneously. 2—The first steps in the manufacture of the linings are mixing and primary molding, after which they are extruded in strips and automatically cut into ten-foot lengths

PHOTOS, COURTESY MARSHALL-ECLIPSE DIV., BENDIX AVIATION CORP.

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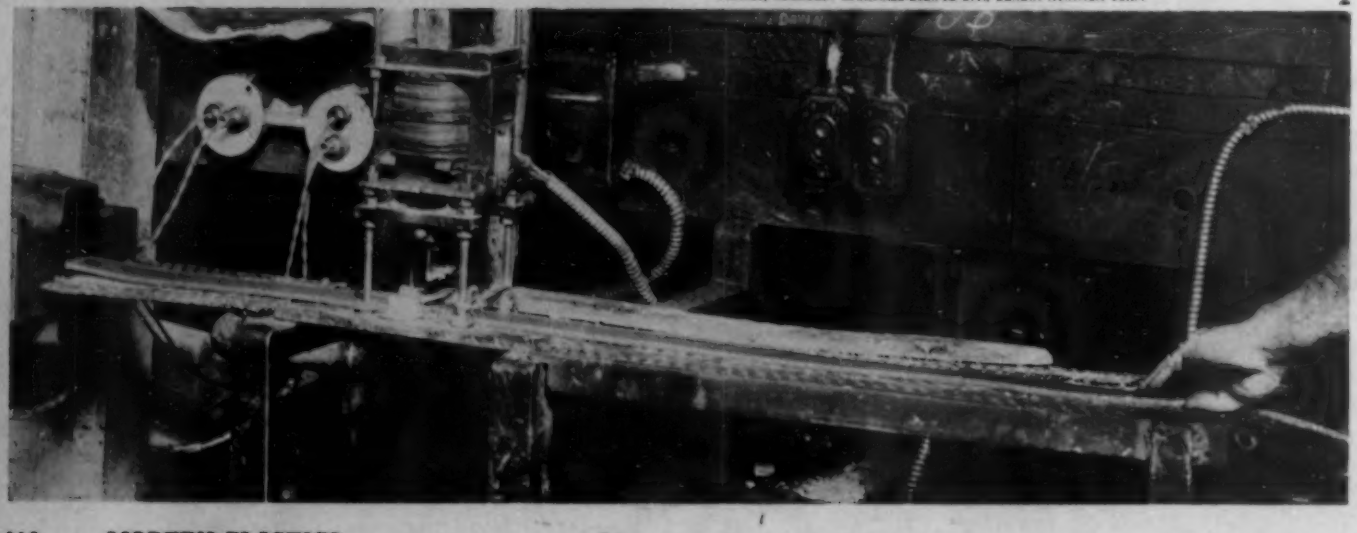

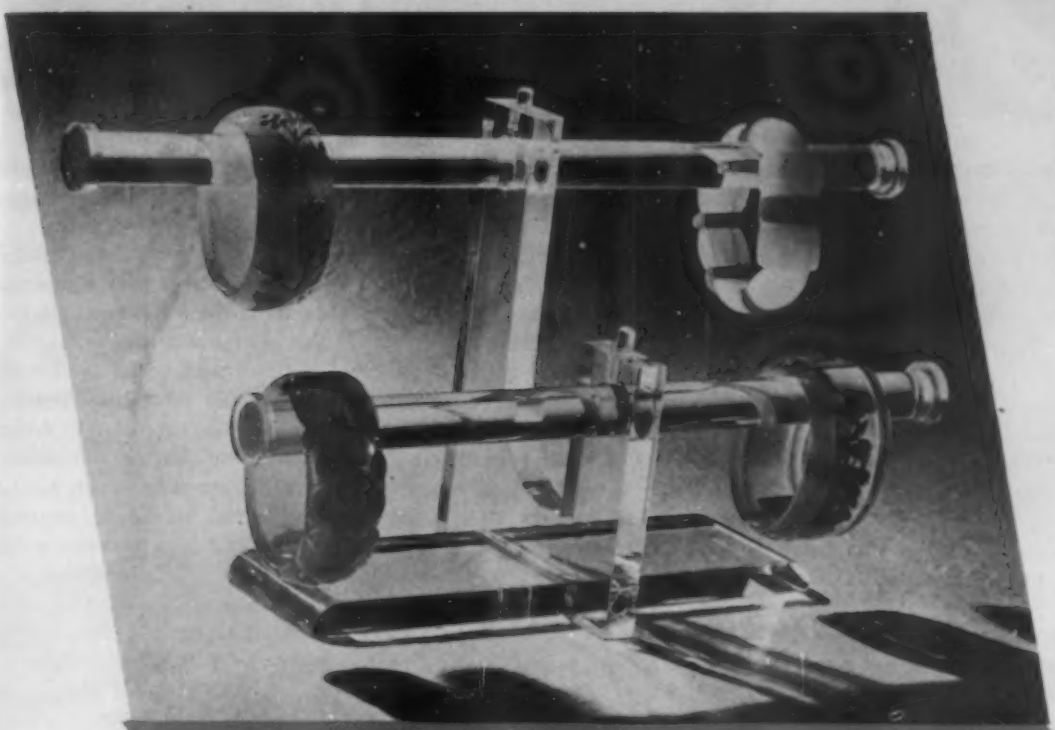

1—*Styling in plastics means more than an ability to execute a given design—whether it be this acrylic counter display for bracelets or a cocktail table. Above all, styling demands originality both in conception and in design*

Lobbying for style

by ALEXANDER REYNOLDS*

This article was written as a rebuttal to the story, "Hobby lobbying," which appeared in the December 1944 issue. While we do not agree with all of Mr. Reynold's statements, we believe his article gives emphasis to certain aspects of styling and merchandising which can bear increased attention from both fabricator and end user. As far as the plastics handicraft story is concerned, Mr. Reynolds seems to have somewhat misinterpreted our views as expressed in that article. The material in "Hobby lobbying" centered around the enjoyment that can be derived by service men—and civilians—from handicraft work with plastics rather than any commercial benefits that might accrue to them from such activity. Of course, there are always a few gifted individuals who will turn any avocation into a vocation—and plastics handicraft work is no exception to this rule.

THE recent article in MODERN PLASTICS called "Hobby Lobbying"[1] is but one of a series which have appeared in *Popular Mechanics* and numerous other publications giving the impression that one can start in the business of forming plastic sheet on a shoestring. It can be done, no doubt of it. But—there is one qualification which has been totally overlooked and that is an ability to design and style, using plastics as a medium.

The experiences of Jay Tyson, one of the pioneers in the styling of plastics display fixtures and furniture, will serve to show what we mean by *style forming of plastics*, as opposed to mere fabrication of sheet, rods and tubes.

[1] "Hobby Lobbying," MODERN PLASTICS, *21*, 95-99, 200 (Dec. 1944).

Almost every city in the country has one or two little shops making plastic picture frames, coat hangers, cigarette boxes, envelope openers, corner shelves, trays, and such articles. Usually clear cast material is used—acrylic scrap as a rule. In fact, during this past holiday season cigarette boxes of crudely cemented methacrylate scrap appeared in the dime stores—items which hitherto had been seen only in the deluxe gift shops priced from 5 to 10 dollars. Since this is but the beginning of a flood of such articles to appear on the market from "hobby lobbies" which mushroom, flourish and die, it is well to examine in detail the story of a going concern which will continue to be an established business long after the flurry of many small acrylic scrap fabricators have realized their limitations and sought other outlets for their energies.

Over four years ago, Jay Tyson, by profession a designer and stylist, began to see the possibilities of using the sheet, rod and tube plastics which were beginning to appear on the market in the manufacture of store display fixtures. Here were no limitations as to temperature range, tolerances, moisture absorption, shrinkage, warpage, and all the other things that must be considered in the usual application of plastics. From a modest beginning he has built up a really sizable business, and some of the things he has learned may help to temper current excitement about plastics fabrication.

One thing that immediately strikes you about Mr. Tyson is his willingness to tell how he handles, machines and forms plastics. Far from being secretive and afraid to admit competition, as are some plastics fabricators, he welcomes it. In fact he has knowingly taken into his shop for a period of apprenticeship, men who intended to go into the same business as himself—and they are in business today. But, and

again we qualify, they still look to their former employer for the majority of their ideas.

When he begins to work on a new line of display fixtures, Mr. Tyson may sit at his drawing board and produce a sketch. But before it is finished he is in the shop, actually making a model, changing and redesigning as he goes. When it is completed, it is submitted to the buyer for approval. Perhaps further changes may be necessary. Perhaps production begins at once. Sometimes, when the order is larger than he can handle in his own shop, he calls up one or two of his former employees and engages them to fabricate the fixture in volume.

The life of a display fixture line is very short—from 6 to 8 weeks. And then a new inspiration, a new design must be produced. That the jigs and fixtures which simplify the production of the job are part of Mr. Tyson's inspiration and styling is self-evident. Not every hobby lobbyist can figure out these time-saving shortcuts—gadgets if you will—for each is unique and specially made. All this sounds very simple, as it is—all, that is, except the natural flair that makes this stylist's designs sell.

On one occasion, in New York, the designer sat in a buyer's office showing a new line of intricate plastics display fixtures. A plastics specialist was announced and the buyer motioned to Mr. Tyson to keep his seat while the "specialist" was being interviewed. The buyer asked the latter what his line was and received the answer—"plastics display fixtures." "Have you any samples?" "No," the fellow replied, "but I can make any of those fixtures (pointing to Tyson's line) at half the price you are paying for them!" Occasionally a buyer falls for such an offer, but when the time comes for a new line to replace the one that has become obsolete he usually has real cause to regret his short-range economy, for true style and appeal are not found at the sign of every plastics fabricator. Style is individuality and personality. It is chic, elusive, timely. And is is a quality that good buyers recognize instinctively.

One other misconception should be corrected, and that is that for 25 dollars one can secure all the necessary equipment to start a little fabricating shop to machine and form plastics. This might hold for a hobby, but not for any volume business. It is true that a double-ended motor with buffers will work, but for any kind of production a really substantial bearing-supported buffer is required—costing not the 10 or 15 dollars which the mail-order models cost, but 300 or 400 dollars. The same is true of a sander that will stand up in any kind of production. A heavy-duty industrial model is required, costing close to 1000 dollars. And so it is with saws—a substantial piece of equipment is needed. The shrewd buyer of fabricated plastics will soon learn to make sure his source of supply is fully equipped with industrial, not hobby-type, equipment.

Most important of all is the fact that styled plastics articles of the type Mr. Tyson makes are never real volume items even though a reasonable amount of fairly rugged equipment may be needed to produce them. At present, it is

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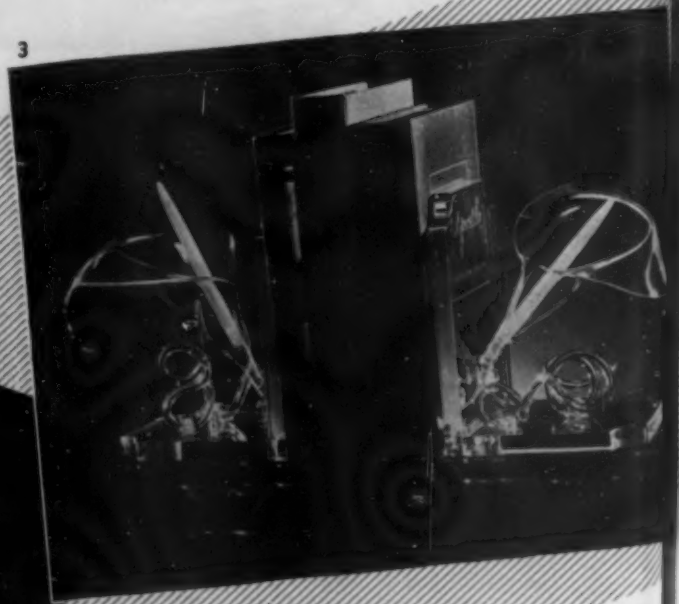
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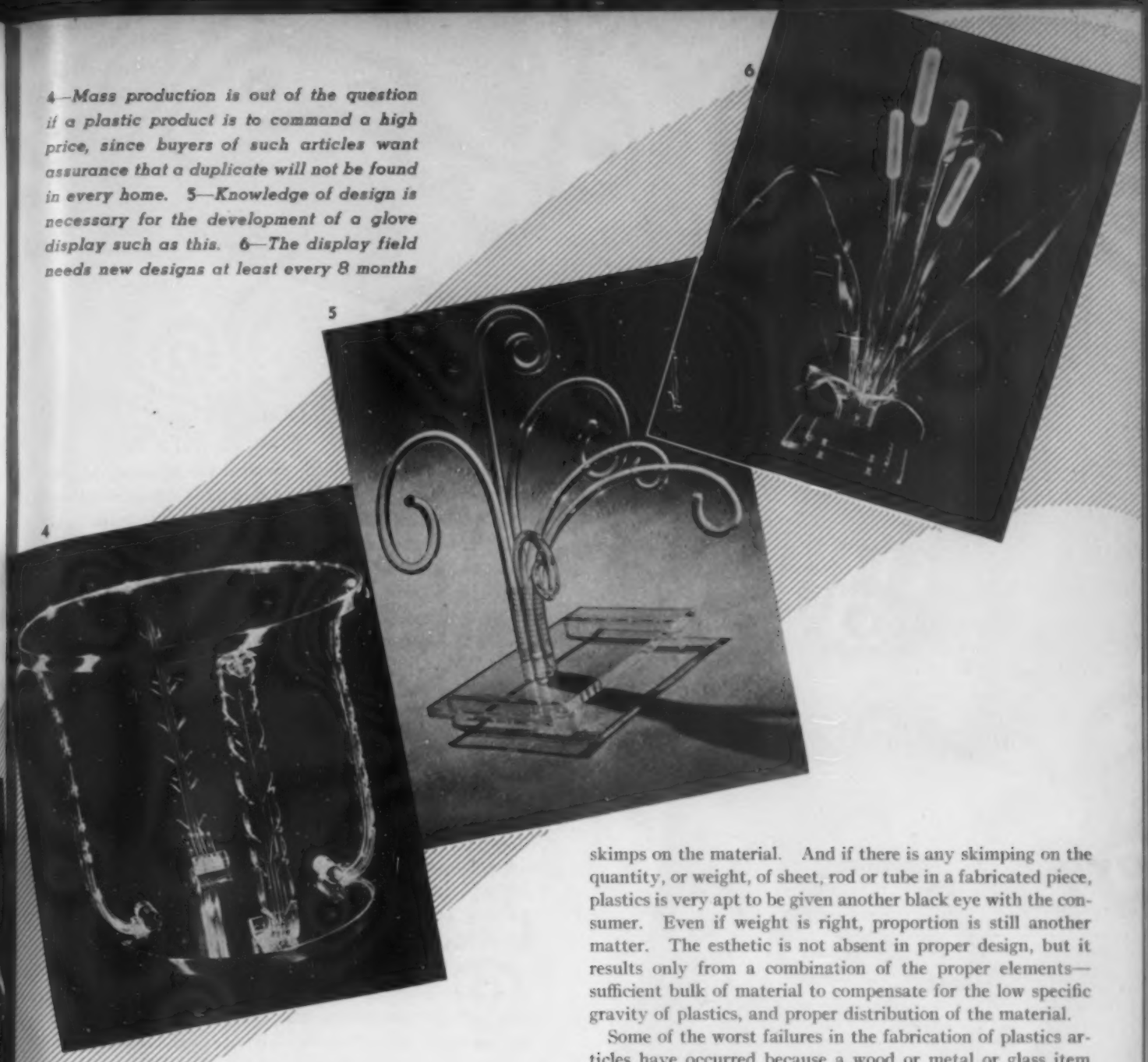
***2**—Given a model, many small plastics processors can duplicate plastics items such as these name plaques. But some of these men who are fabricators only—not designers—run into difficulties when they must originate a new line.*
***3**—If bookends or similar plastics articles are to be considered as luxury items, there can be no skimping on material—a fact that immediately removes them from the low-priced field*



4—Mass production is out of the question if a plastic product is to command a high price, since buyers of such articles want assurance that a duplicate will not be found in every home. **5**—*Knowledge of design is necessary for the development of a glove display such as this.* **6**—*The display field needs new designs at least every 8 months*

possible to achieve a volume of sales on a commonplace plastic cigarette box. But this designer does not aim his products at such a readily saturated or temporary market. He seeks instead to produce, say, 40 or 50 graceful lily bookends, which will be unique in the world and far beyond the conception of the ordinary hobbyist. Only one outlet in each of three or four major cities is given such an item which may retail between 40 and 50 dollars. The buyer of such an article is bound to feel his money has been well spent, for a replica of his purchase will not be staring at him from every counter in the city as would be the case with the cigarette box.

The fact remains that today a decent piece of acrylic resin is still costly. It takes a lot of plastic to give the "heft" or feel of quality to an item—lamp base, table, bookends or even a cigarette box for that matter. It naturally follows that it is virtually impossible to fabricate items such as those mentioned above for sale at a low retail price unless the producer skimps on the material. And if there is any skimping on the quantity, or weight, of sheet, rod or tube in a fabricated piece, plastics is very apt to be given another black eye with the consumer. Even if weight is right, proportion is still another matter. The esthetic is not absent in proper design, but it results only from a combination of the proper elements—sufficient bulk of material to compensate for the low specific gravity of plastics, and proper distribution of the material.

Some of the worst failures in the fabrication of plastics articles have occurred because a wood or metal or glass item was merely duplicated in plastics and not completely restyled for the new material. As a result, another flimsy and unsatisfactory application of plastics makes its way into the market, and the customer writes it down in his memory.

Mr. Tyson faces the fact that plastics for fabrication are still expensive and aims at markets and applications where cost is a secondary factor. He is constantly disappointing inventors who want items restyled for plastics by disillusioning them with the realities of plastics as a prospective material. He points out its high cost, its relative softness, its relatively low resistance to heat, its tendency to cold flow, its low resistance to abrasion, its scarcity under present conditions, the special precautions necessary to prevent damage during shipment, and the definite limitations as to size that must be considered since extruded shapes above a 2-in. diameter are rare and large cast shapes very costly.

In the end it is style that makes for sales appeal. Under present fantastic conditions and in view of the glorification that plastics are receiving in the form of postwar promises, some people may lose sight of this fact. But ultimately the well-styled item—such as those which illustrate this article—is the one that lasts, and gives the customer a feeling of quality.

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1 Imperfections in material are often caused in winding by a bobbin that is not perfectly centered and balanced. American Paper Tube Co. has decreased such flaws with its Plasti-weld automatic loom bobbin. Plastic impregnated paper is laminated around a mandrel to form a smooth surfaced and abrasion resistant bobbin barrel. The molded Co-Ro-Lite head is highly uniform

2 An ingenious method for augmenting a too-short supply of plastic rods for tool handles, stiffeners, etc., has been developed by Glenn L. Martin Co. Burned-out fluorescent tubes are trimmed at one end, filled with liquid Catabond or Catavar and cured in an oven. After curing, the tube is chipped from the plastic, leaving a perfect rod requiring a minimum of polishing

3 The problem of keeping crowded suitcases free from a liberal sprinkling of toothpowder from wartime cardboard containers, has been solved by Ben-Hur Products, Inc., Los Angeles, with a Lumarith Advance Dispenser molded in a variety of colors

4 With winter weather getting colder and colder each year, the consequent epidemic of colds brings with it the need for great care. For this reason, Wm. S. Merrell Co. has developed a Vonedrine inhaler with a tube molded of gray and white Beetle by Plastics Div., Owens-Illinois Glass Co., which is strong, light-fast and convenient

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5

PLASTICS IN REVIEW

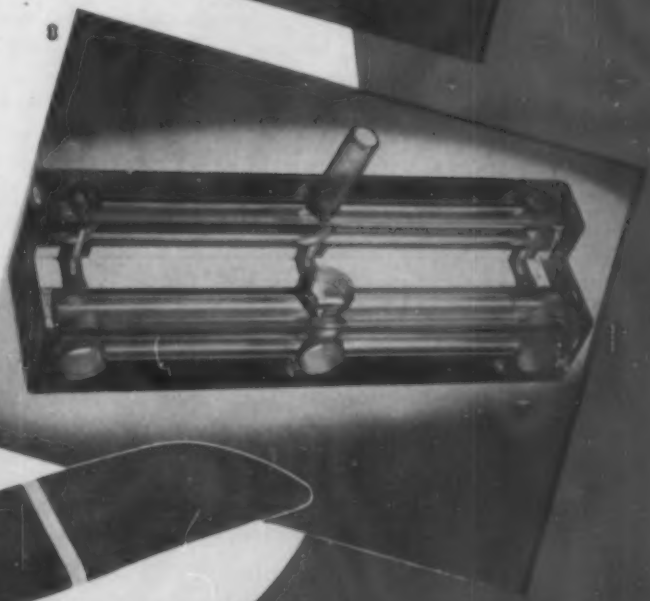
6

5 The material that now protects a Naval officer's cap from rain will find a postwar use in ladies' umbrellas. Eichenbaum Umbrella Co. has already placed products of Terson Voile, a vinyl resin coated material developed by Athol Mfg. Co., in a few key stores to test consumer reaction. The voile, weighing only 2 oz. per sq. yd., will stand 10 lb. hydrostatic pressure

6 The three primary virtues of every plastics product—improved appearance, decreased weight and reduced production costs—have been achieved by Warren Plastics Corp. in its cellulose-filled Durez fuze tips for glass-bodied plug fuzes. These tips have all the good properties of the mineral-filled tip formerly in use, plus the added advantage of greater strength

7

7 While a life jacket will keep a man afloat until rescued, he is often missed by rescue ships because he is not immediately discernible in the darkness of a choppy sea. Clipped to the jacket or headgear, these life-jacket lamps with red or clear Tenite globes injection molded by Plastal Specialties Co. point the way to rescue



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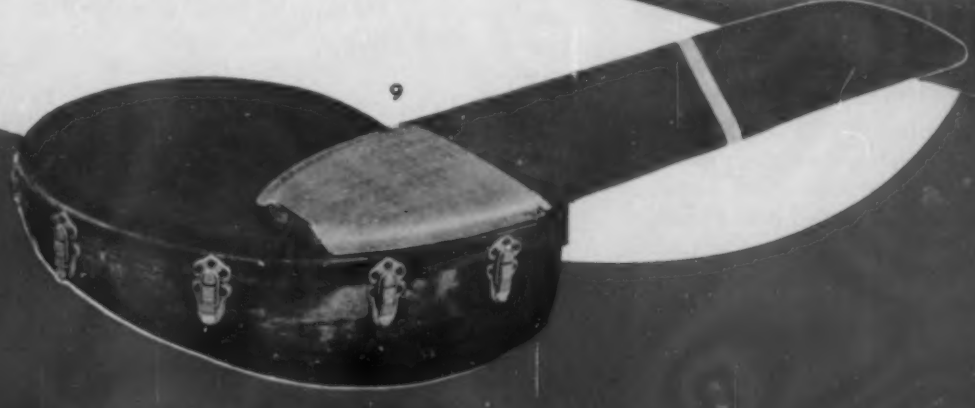
8 When an item such as these battery filler units of Plexiglas manufactured by Prest-O-Lite Battery Co. shows no sign of deterioration after more than two years of almost constant contact with 60 percent sulfuric acid at 90 to 100° F., it bears more than adequate testimonial to the plastic employed

9 Supplies dropped from a plane over impassible territory or to isolated troops are secured against damage by this "sky hook" supply landing container. Manufactured by Stack Plastics Co. of 6 layers of Laminac bonded canvas and glass fiber, the hook spins as it falls, breaking the force of the drop and landing materials undamaged



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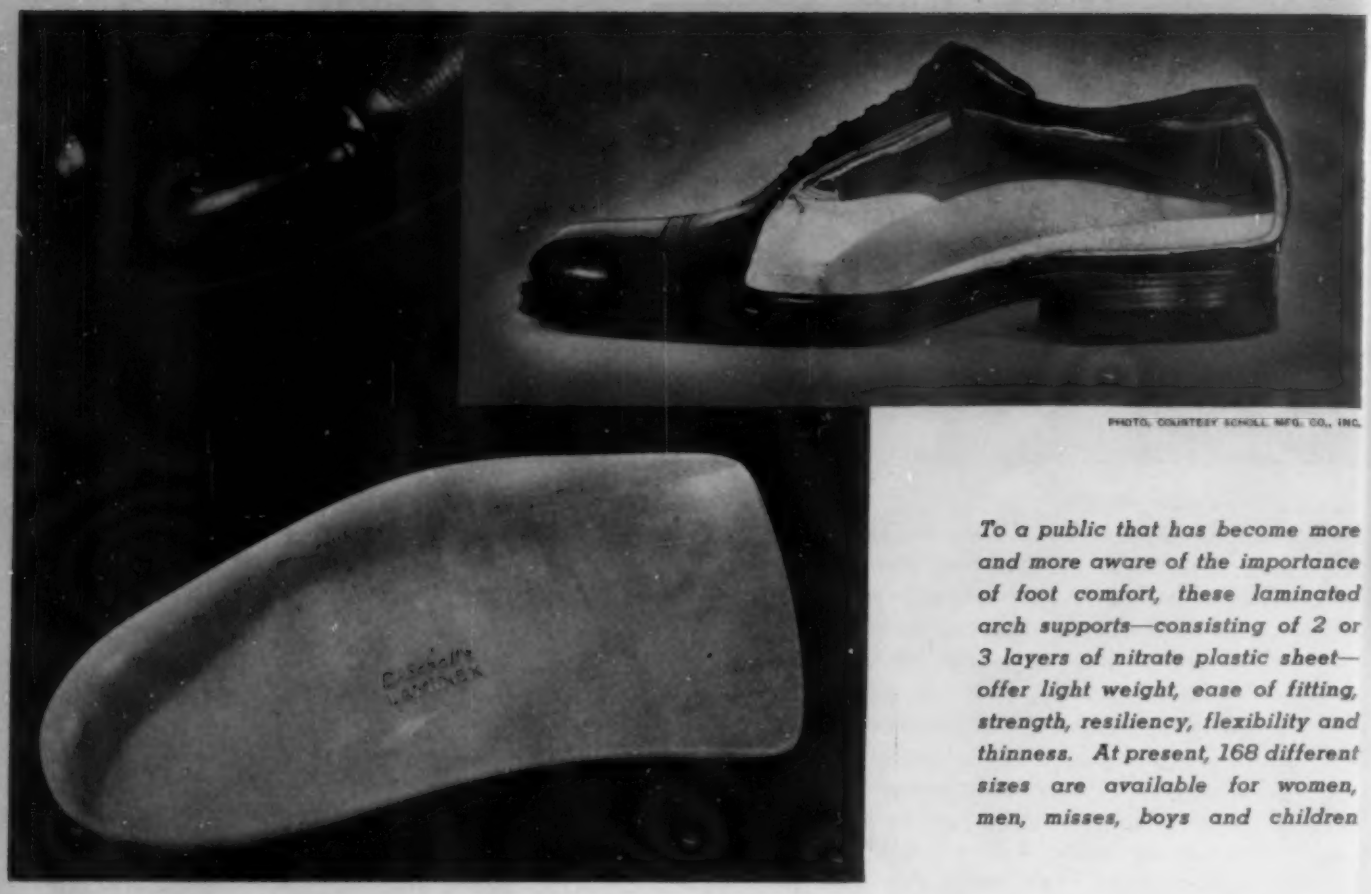


PHOTO, COURTESY SCHOLL MFG. CO., INC.

To a public that has become more and more aware of the importance of foot comfort, these laminated arch supports—consisting of 2 or 3 layers of nitrate plastic sheet—offer light weight, ease of fitting, strength, resiliency, flexibility and thinness. At present, 168 different sizes are available for women, men, misses, boys and children

Walking on air

SIX years ago, the president and directing head of the Scholl Mfg. Co., Inc., large manufacturer of foot appliances and preparations, became convinced that plastics would fill an important place in his business. Experiments with the first plastic product—an arch support—were undertaken immediately and there followed a period of endless improvement and development in which models and molds were often changed as many as twenty-five times on the basis of "if it's not exactly right, it's wrong." Today, this same concern has its own plastics department, has perfected, produced and merchandised in volume a full line of laminated plastic arch supports, and is making postwar plans for other plastics products.

It is not alone the design, construction and utility of these plastic supports that have made them an outstanding sales success. The advertising campaign, featuring "Featherlight plastic" arch supports has produced far more than ordinary results, attributed by the company's advertising manager to the fact that "we have found the word 'plastic' to be a magic word in advertising to the public."

The company, with headquarters in Chicago, has a sales and distributing organization extending throughout the world and including company-owned retail shoe stores and foot-comfort shops, dealer-owned shops handling Scholl products exclusively, special service departments in department stores, shoe stores, drug stores, variety stores, and many other types of outlets—facilities which have simplified the problem of merchandising a line that requires individual fittings.

Development of the present line of laminated arch supports is an interesting chapter in plastics because of the difficult problems which they presented.

These laminated supports, consisting of two or three layers of cloth and three or four layers of a cellulose nitrate sheet—depending on the strength required—are made in 618 different sizes for women, men, misses, boys and children. All sizes and widths, and three elevations are provided for in two models—a longitudinal and a combination longitudinal and metatarsal support. For example, women's arch supports are available with low, medium and high elevations in sizes ranging from 3 to 12, and widths from AAAA to EEE.

Not only did this large line involve a molding and production task of the first magnitude, but it imposed a rather difficult merchandising problem since not only must the supports be individually fitted but they cannot be altered in size, as is the case with supports made of some other materials, although certain minor adjustments can be made. As a result, stores must either carry a complete line or a very large representative selection. Most of the molds for the line were made in the Scholl plastics department. This division also handles the production, which is almost equivalent to the filling of individual orders for various sizes and types of supports.

It was found that a laminated support met all requirements for comfort and effectiveness, including light weight, ease of fitting, resiliency and flexibility, strength, thinness and proper design for heel elevation. Each of the 618 sizes and styles is designed to fit (*Please turn to page 194*)

A molded motorboat hull

by A. E. LUDERS*

1—The first model for the molded motorboat hull had a combination round and "Vee" bottom. **2***—The second model had a true "Vee" bottom.* **3** *and* **4***—The third model was similar to the second except for modifications of the chine angle and deadrise. This proved to be satisfactory*

SMALL, fast and extremely seaworthy. Such were the qualifications laid down by a group of scientists when it approached the Luders Marine Construction Co. with the request that a cabin motorboat be designed for use in important biological survey work off the rugged coast of Vancouver, B. C. The agreement called for delivery as soon as war conditions would permit. This indefiniteness as to date was due entirely to wartime prohibitions on the use of various materials—particularly critical metals. As far as labor was concerned, the company had occasional quiet intervals between Government contracts when its workmen welcomed the idea of temporary employment in the production of a craft of this type.

There were no prohibitions, however, upon planning, and design work was undertaken immediately. A year previous this marine construction company had produced a 38-ft. molded plywood racing sloop. Bearing in mind the beatings which the hull of this boat had successfully withstood in gales and seas far exceeding those usually encountered by racing boats, the company decided to use molded plywood for the body of the cabin motorboat.

Since there was plenty of time before actual construction could be started, work on the design of this motorboat was given more than usual attention. Several models were built on a scale of 2 in. to the foot, and given open water tests in order to observe their performance characteristics. Towed at a little less than half the desired speed of the full-sized boat, the behavior of the models was estimated to duplicate, in miniature, the performance that might be expected of the actual survey boat. Since waves made by the model were in scale and the trim took the same angle as that desired on the parent ship, it was possible by a measurement of the tow-rope resistance of the model to estimate the horsepower needed by the full-sized boat if it were to attain certain desired speeds. This power experiment did not come within the scope of the open-water experiments, but was checked at a later date at the Government Model Basin in Washington.

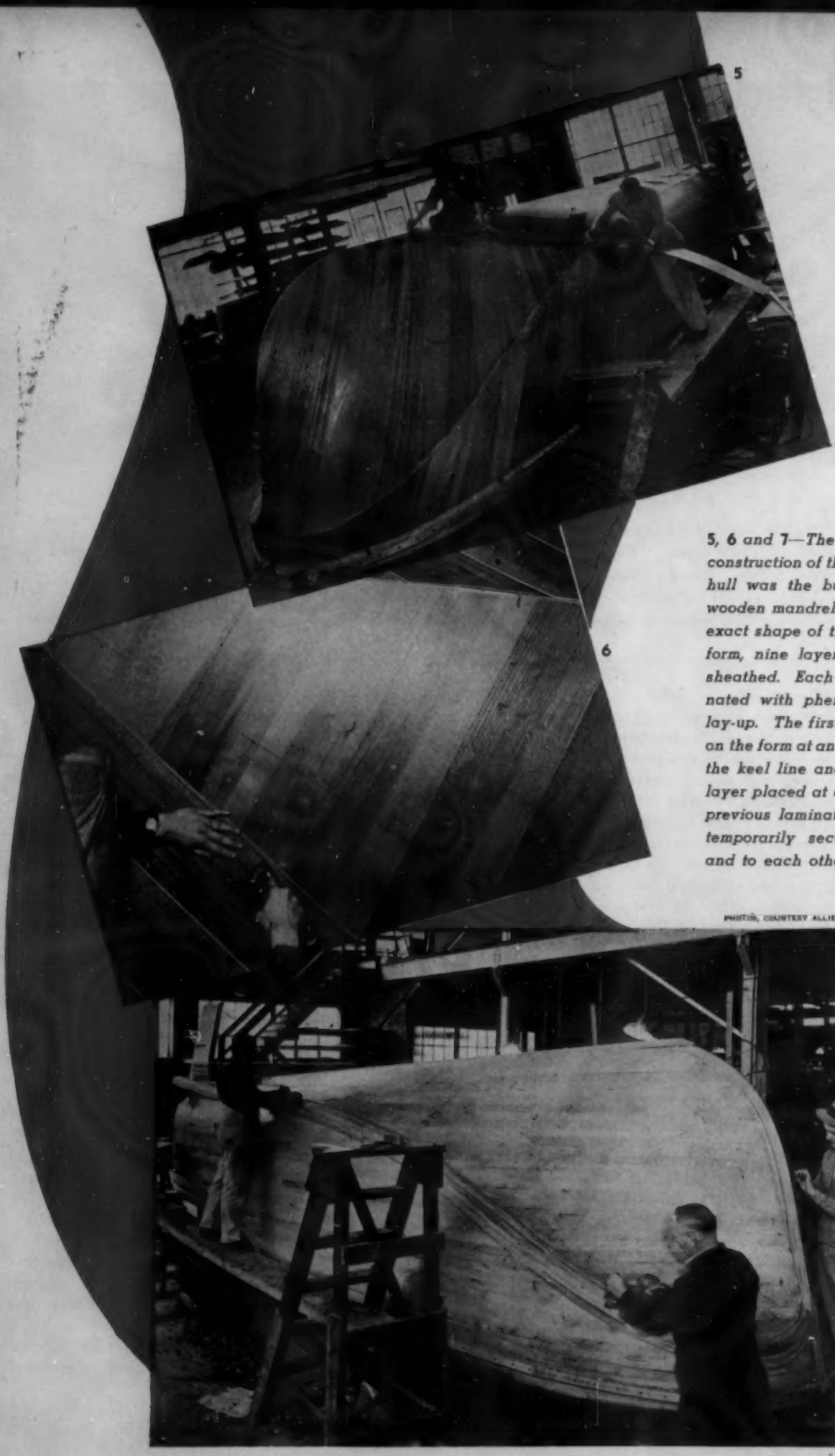
A number of different models were tested (Figs. 1, 2 and 3). The tiny experimental boat shown in Fig. 1 has a combination round and "Vee" bottom which proved very unsatisfactory. The second model (Fig. 2), built with a true "Vee" bottom, performed well but had an untrue trim. Slight modification of the chine angle and deadrise of this second model resulted in a third and final model which was accepted as satisfactory. All of these photographs were taken at speeds which in the models almost equaled that of a full-sized ship traveling at 23 miles per hour. A special spirit level, installed to measure the trim angle, can be seen in Fig. 3. The tow rope is not visible. The angle in the point of hull attachment of this tow line corresponds to the angle of the propeller shaft.

The plan view (Fig. 8) shows the layout of this boat which follows the accepted arrangement in equipment of the better-appointed Florida fishing boats which have accommodations for two people.

At about this point in the development of the design, the Government made available special priorities for the building of experimental craft; and construction of the plywood motor boat was undertaken immediately. The initial step was the construction of a solid wooden mandrel conforming to the exact shape of the hull of the boat. Over this form nine layers of veneer were sheathed—each of the layers being impregnated with phenolic resin before lay-up. The first layer of veneer was placed on the form at an angle approximately 45° to the keel line and each successive layer was placed at a 90° angle to the previous lamination. As a temporary means of holding the layers in place, the laminations were secured to the form and to each other by means of wire staples.

When the planking was finally completed, the entire unit—comprising the form and plywood layers—was placed in a

* Luders Marine Construction Co.



5, 6 and 7—*The initial step in the construction of the molded plywood hull was the building of a solid wooden mandrel conforming to the exact shape of the hull. Over this form, nine layers of veneer were sheathed. Each layer was impregnated with phenolic resin before lay-up. The first layer was placed on the form at an angle about 45° to the keel line and each successive layer placed at a 90° angle to the previous lamination. Layers were temporarily secured to the form and to each other by wire staples*

PHOTOS, COURTESY ALLIED AVIATION CORP.

large rubberized bag. The vacuum which was then drawn in this bag forced the laminations tightly and uniformly against the form. The assembly, still covered by the rubberized bag, was rolled into a large steel cylinder, or autoclave. After the pressure-tight door had been dogged tight, steam and pressure of approximately 75 lb. was introduced. This additional pressure caused the plys to press more tightly against each other and to fit more closely the shape of the form. The steam pressure of 75 lb. not only created the pressure needed for molding but produced a temperature in the autoclave of approximately 300° F. This combination of pressure and temperature polymerizes the phenolic resin to produce a one-piece plywood structure which follows exactly the form of the mandrel. This structure is waterproof and fungus-proof and, due to the fact that the resin has impregnated the wood, exhibits almost no tendency to swell or shrink. The molded shell as it emerges from the autoclave is so smooth that only the most moderate sandpapering is required before the application of paint.

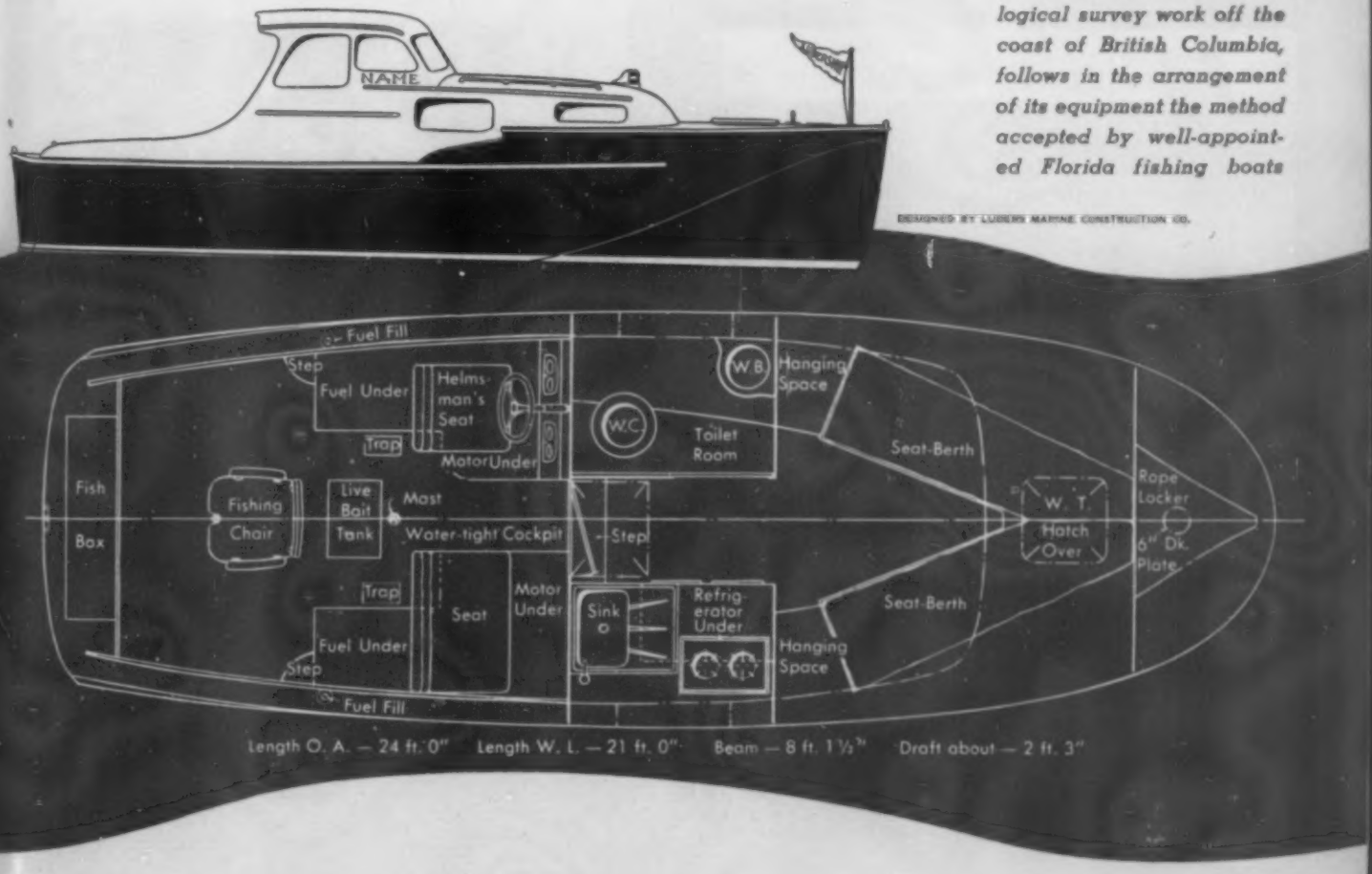
There will be some delay in the trial runs of this boat due to the requisitioning by the Government of the two 50-hp. Gray motors which had been purchased for the boat. However, it is expected that another pair of motors will be available this Spring, at which time test trips will be undertaken and any necessary adjustments made.

Despite a season's experience with molded plywood hulls which demonstrated the improved rigidity and strength of this construction, the company built the motorboat with a thicker shell than is usual when planking is employed for this size craft. The heavier 9-ply diagonal construction was intended to compensate for the hard usage to which the boat may well be subjected. This hard usage is a matter not only of the boisterous seas common in the section of the Pacific where boats of this type will operate, but also one of anchorage.

The Biological Society Laboratory is perched on a rocky cliff with a sheer straight drop to the sea on a section of the coast where the tidal range is approximately 12 feet. The mooring problem was finally overcome by building a boathouse overhanging the water. A 4-ton electric hoist was installed in the boathouse and arranged so that it could haul the boat straight up into the protection of this shelter. Yachtsmen are well aware of the great strain placed on the structure of a boat whenever it is hauled out of the water—even though a cradle is used. For this reason, as an added factor of safety, the boat was given a thicker hull. Yet another advantage that may be expected to accrue to the boatbuilding industry through the use of molded plywood is the elimination of uneven swelling of putty and planking which had previously presented a serious problem.

The marine construction company states that the design and construction of this motor boat has already aroused wide interest. Not only does the firm plan to build additional boats of this type after the war, but it intends to make available to certain reputable concerns nested shipments of the bare molded hulls which can be completed in the widely scattered plants of the purchasers, enabling the latter to equip them according to their individual requirements.

Credits—Molded by Allied Aviation Corp. for Luders Marine Construction Co.



8—*The layout of this boat, intended for use in biological survey work off the coast of British Columbia, follows in the arrangement of its equipment the method accepted by well-appointed Florida fishing boats*

PLASTICS

WHEN HOUSEWIVES WERE ASKED, IN a series of consumer surveys, the improvements they would most like to see in their vacuum cleaners, a major suggestion was the elimination of the dirt bag, the emptying of which, they felt, was a most unpleasant and unsanitary operation.

The Electrikbroom is designed to obviate this unpleasantness and to correct weight and operation objections. Weighing only 6½ lb., this cleaner substitutes a quick-emptying cup molded of special shatter-resistant phenol-formaldehyde for the clumsy dirt bag. This material was chosen because of the molding problem presented by the irregular contours of the cup, because of its light weight and because of its smooth surface to which the dirt will not cling.

Present production of the Electrikbroom is limited to a few sample cleaners. When the now critical material employed in its construction becomes available, large-scale production of the vacuum cleaner will, without doubt, be undertaken.

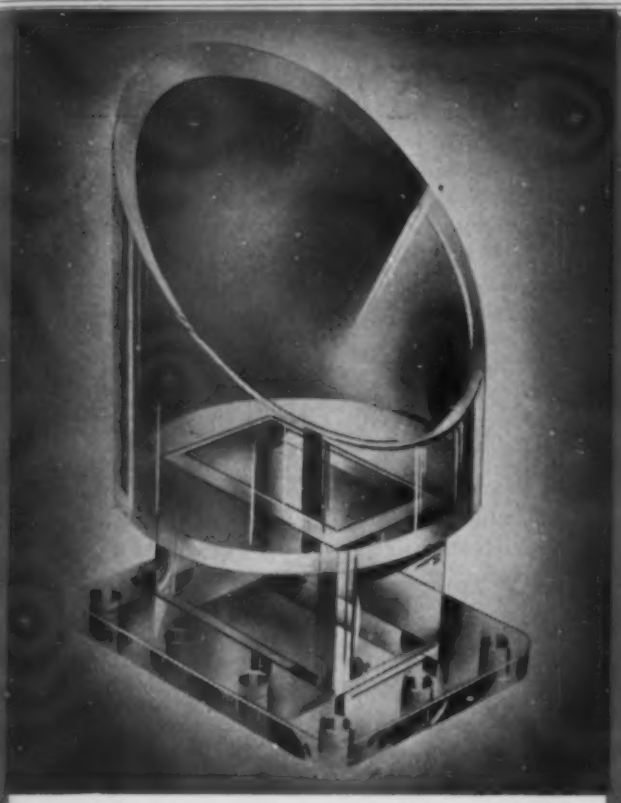
Credits—Material: Bakelite. Cup molded by Plastic Molding Corp. for Regina Corp.

WEIGHT IS HELD AT SUCH A PREMium on planes that manufacturers constantly seek new materials to lighten them without impairing efficiency. Such a factor prompted the choice of macerated phenolic resin impregnated canvas for leading edges of carburetor air scoops on PBM's, reducing the weight by about one-half and giving a smoothness and dimensional accuracy to the part which was hitherto lacking.

These edges are molded on a hydraulic press in a 3-piece die—steamheated chase, split cavity and a male portion attached to the upper press platen. The split cavity, filled with molding material is set inside the chase on the press bed and the press closed at 275–500 p.s.i. pressure. After the material reaches a plastic state, pressure is increased to 2200 p.s.i. When the press opens after curing, split cavity, chase and part adhere to the male portion. A knock-out plate is inserted and knock-out pins penetrating the male part knock the split cavity onto the press bed. The cavity is then opened to remove the molded part from the mold.

Credits—Material: Dilecto. Molded by Continental Diamond Fibre Co.

PRODUCTS*



PRESENT ADVANCES IN PRECISION fabricating of acrylics not only are meeting exacting Army and Navy specifications but also opening postwar possibilities for industrial applications. These advances in clude maintenance of close tolerances in drawing and forming, machining and drilling, and cementing.

An excellent example of such precision is a special acrylic housing for the Navy, consisting of 8 parts: a $^3/_8$-in. thick base with cutout and 10 polished holes, 4 walls of a rectangular block mounted on the base, and a cylinder, cut diagonally at the top and having a cutout base and top piece, mounted on the block.

In actual use, a metal bar slip fits through the base, then the block and finally through the cylinder base. It was therefore necessary to maintain perfect alignment. Tolerances were held to 0.005-in. in the finished product which gives the impression of being in one piece. A special cement retains the clarity of the material while giving bonding strength.

Credits—Material: Plexiglas. Housing manufactured by Plasti-glo Mfg. Co.

* Registered U. S. Patent Office.

AS A SHIP'S GUNS GO INTO ACTION, the resulting concussion aboard the vessel is so great that every part is badly shaken. The effect may be chaotic if movable parts are not pinned down. Even the immovable details, if they are not sturdy in construction and of a hardy material, may shatter under the strain.

The knowledge of such effects prompted the Navy to select shades molded of urea for their Type HS berth fixtures, since the material would not shatter under concussion. These shades, which are an excellent example of the versatility of urea, are approximately $4^1/_4$ in. in depth and have a diameter at the large end of about $4^1/_2$ inches. At the small end, which has a diameter of $3^5/_{16}$ in., are 3 extending brackets with holes for attaching the shade to the fixture. The shade, near-white in color, has a considerable degree of transparency, is smooth on the inside for utmost reflectivity, and has ribs about $^7/_8$ in. apart on the outside to improve the appearance and give additional strength to the shade.

Credits—Material: Bakelite urea. Molded by Chicago Molded Products Corp. for Benjamin Electric Mfg. Co. for U. S. Navy.

Forming vulcanized fibre

by G. A. ALBERT*

ONE of the oldest members of the plastics family,[1] vulcanized fibre has demonstrated its versatility not only in manifold prewar applications but in the production of extremely necessary war matériel. In addition to possessing excellent electrical and mechanical properties this material is capable of being bent, formed and drawn—characteristics that have extended its range of utility into the forming of large parts of complicated contours such as jettison gasoline tanks, helmets for tank crews, aircraft flare racks, structural angles and channels for bulletproof gasoline tanks. Large quantities of vulcanized fibre were employed at the outset of the defense program not only for its long-established applications but also as a replacement for critical metals, but immediately became so critical that it was placed under allocation and is still subject to WPB Order M-305.

Basically vulcanized fibre is a converted cotton cellulose, hardened by a chemical—later removed—into a pure cellulosic material which is then dried, calendered and pressed. A tough, resilient, horn-like plastic material, vulcanized fibre possesses high mechanical strength, good electrical properties, excellent machinability, good forming qualities, high resistance to wear and abrasion, durability and light weight. Its density is approximately one-half that of aluminum. Many varying grades of vulcanized fibre have been developed to fulfill special requirements. Table I lists the ranges of

* Sales development engineer, National Vulcanized Fibre Co.

[1] Vulcanized fibre was first made commercially available following the granting of British Patent No. 787 to Thomas Taylor in 1859 for a method for "Increasing the Strength of Paper." In 1908 U. S. Patents Nos. 897,757-8-9 were issued to Marshall Brothers of National Vulcanized Fibre Co. for a continuous fibre-making machine which made possible large scale production of vulcanized fibre.

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1—The ability of vulcanized fibre to be bent, formed and drawn has extended the range of utility of this material into the forming of large parts such as this welder's helmet and into the production of such necessary wartime materiel as industrial helmets, crowns for the helmets of tank crews and shin guards. 2—This internal brace for a Vega PV-1 self-sealing fuel cell shows the straight vulcanized fibre angle and the curved angle

TABLE I.—MECHANICAL AND ELECTRICAL PROPERTIES OF VULCANIZED FIBRE

Density, gm./c.c.	1.0–1.4
Tensile strength, lb./sq. in.	6,000–12,000
Compressive strength, lb./sq. in.	20,000–30,000
Flexural strength, lb./sq. in.	12,000–20,000
Shear strength, lb./sq. in.	11,000–15,000
Impact Izod, ft. lb./in. notch	1–8
Rockwell hardness	R-60 to R-100
Softening point	None
Max. continuous operating temperature	225° F.
Dielectric strength, volts/mil (s.t.) 1/8 in. thick	150–250
Power factor, 1000 k.c.	0.03–0.08
Dielectric constant, 1000 kc.	4–7
Water absorption (2 hr.) 1/8 in. thick, percent	15–25

some of vulcanized fibre's mechanical and electrical properties.

The outstanding forming properties of vulcanized fibre, while recognized almost from the beginning of the industry, have been exploited to best advantage during the past ten years as a result of improvements in the making of forming-sheet fibre and especially in die designs provided with spring or compressed air pressure pads.

Forming procedure

The first stage in forming vulcanized fibre—either sheet or tubing—is to soften it by immersion in water maintained at about 160 to 210° F. or in a live steam chamber. The immersion time depends upon the part to be formed. For objects of simple shape, the fibre may be used with its surfaces moistened by wiping with a wet cloth or dipping in water. For complex shapes, it may be necessary to soak the fibre 30 min. or longer.

Upon removal from the water or steam, the fibre is placed in a heated metal forming die, and held there under pressure until the water is sufficiently evaporated to permit the finished piece to maintain its shape. This time varies from a few seconds to not longer than 6 minutes. To permit heating by steam, electricity or both, the dies are constructed of metal. Steel and cast iron are most satisfactory but other metals can be used.

The temperature of the die is determined both by the construction of the part being formed and by the thickness of the fibre. Water-soaked parts require temperatures ranging from 220 to 300° F. If a small part is to be made, the die may be heated by conduction from the heated press platens. But if the formed part is large, the die should be cored out so that steam or electric heating resistance units may be installed.

The pressure that is necessary for forming fibre parts depends upon such factors as the shape of the part, the depth of the draw and the thickness of the fibre. Many simple shapes—helmets and welder's shields—require pressures on the projected area of about 200 p.s.i. For large items or for parts where only the periphery is to be formed—jettison tanks and cylindrical covers—the amount of force that is needed is usually calculated on the linear dimension of the periphery. This value rarely exceeds 700 lb. per lineal inch. Because these relatively low pressures will suffice, standard hydraulic press equipment is adaptable for forming fibre parts.

Drawing operations

In forming or drawing, the fibre must be stretched at some points and "crowded" or compressed at others. Under tensile pull, wet vulcanized fibre will stretch as much as 25 percent or will compress or crowd about 50 percent. For example, a circular disk, 3-in. in diameter, will form a cup with an inside diameter of 1 1/2 in. This means that the periphery around the 3-in. disk was reduced to 1 1/2 in.—a 50 percent reduction. Since this forming was achieved without wrinkles, it is evident that the fibre fused and crowded itself together uniformly around the top of the cup.

PHOTO, COURTESY NATIONAL VULCANIZED FIBRE CO.

3—The spherical bottom for this air mail pick-up bag has a 6-in. draw for a 12-in. in diameter opening. The part was successfully drawn from 1/4 in. fibre

If the part is not complicated by deep draws, it can be made in a regular two-piece die. However, where the draw is severe, a pressure pad must be employed. Naturally, every formed part presents distinct problems and no set rules can be established as to what can and cannot be drawn or formed. If the part is designed with right-angle bends of the proper radii in the drawn part—such as an approximately square box—the depth of the draw should be about one-third of the diagonal of the opening of the box. When the draw is spherical, as in the seamless crown of a miner's helmet, the depth of draw should approximate one-half the average diameter of the opening.

While fibre of all thicknesses can be formed, considerable attention must be given to the radii of bend and depth of draw when thicker materials are used. For athletic parts, helmets and similar items, thicknesses are usually between 1/16 and 3/32 in.—thicknesses which permit a good draw while imparting strength and rigidity to the finished part. The jettison gasoline tank is made in two parts from 3/32-in. fibre. Each half is finished with a flange and then the two are riveted together. A spherical bottom for an air mail pick-up bag (Fig. 3) was successfully drawn from 1/4-in. fibre. This very interesting part has a 6-in. draw for a 12-in. diameter opening at the bottom. (*Please turn to page 202*)

The new fire-resistant plastic in both sheet (Fig. 1) and molded (Fig. 2, left) form shows only slight carbonization when subjected to the flame of a blow torch. In contrast, the part molded from the old plastic (Fig 2, right) cracked where it caught fire when given the same treatment

A safeguard against shipboard fires

SOMETIMES, a damaged electrical connection aboard ship causes a sudden flare-up around the instrument panel—a fire that today can be quickly extinguished without ill effects to the men or the equipment. But such was not always the case before the Navy Department Bureau of Ships specified the use of "glass-fiber melamine resin" panel board on all Navy ships now being built, unless it is impossible to install the new-type board without delaying delivery of the vessel, and required the ships now in service to change to the new board at the earliest possible date.

Prior to the development of this new material and the issuance of the Navy directive, a submarine crew was in danger, in the case of an instrument-board fire, of near asphyxiation as the result of toxic fumes given off by the organic material, bonded with a phenolic resin, which comprised the panel boards. The danger was equally real aboard surface craft. With warships moving in close formation, any delay—such as might result from a firefighter's inability to approach immediately the source of the flame because of stifling fumes—could be enough to throw the ship completely out of control.

Even before Pearl Harbor the Navy Department recognized the need for a new material for the construction of shipboard electrical instrument panel boards and parts that would be more fire-resistant than the material then in use and, unlike this material, would not give off toxic fumes if subjected to contact with flame or intense heat. Battle experience during the early months of the Pacific war served only to emphasize the urgency of the need for such a material.

The laminate then used for panel-board construction—an organic material bonded with a phenolic resin—offered insufficient arc resistance, had a comparatively low combustion point and was a potential source of toxic fumes that could make it extremely difficult for firefighters to get at a fire caused by enemy bombing or shelling. Use of new incendiary explosives made these weaknesses increasingly serious.

Research, initiated by the Navy Department, and carried on in cooperation with materials suppliers and manufacturers of electrical control equipment,[1] resulted in new plastic ma-

[1] L. J. Cavanaugh, General Electric Co., chairman of the Committee. Other manufacturers represented on the committee were: Westinghouse Electric and Manufacturing Co.; I.T.E. Circuit Breaker Co., Formica Insulation Co., Continental Diamond Fibre Co., Owens-Corning Fiberglas Corp., Cyanamid Co., Panelyte Div. of St. Regis Paper Co., Mica Insulator Co., National Vulcanized Fibre Co., Spaulding Fibre Co., Richardson Co. and Taylor Fibre Co.

terials which satisfy the panel-board and parts requirements and, at the same time, have numerous potential peacetime uses in applications where flammable materials and toxic fumes would be a hazard. There are two materials. One is a laminate manufactured in large sheets by bonding numerous layers of glass-fiber cloth with melamine resin. The other one consists of a phenolic resin with a filler of asbestos fibers. The laminated sheets are used for panel boards upon which are mounted various parts molded of the phenolic resin-asbestos material. This new molding compound has an advantage over the glass-cloth melamine-resin laminate in that it can be molded into any desired shape.

The first step in the production of the panel-board material involves the carmelizing or removal of the original sizing present in the glass cloth which is used as the filler in this new plastic. The glass cloth is then passed through a coating bath (Fig. 3). After treatment the cloth is dried and rewound. Finally it is cut and trimmed with a water-cooled diamond-edge copper wheel saw (Fig. 4). Before shipment the panel board is given a thorough inspection by the Navy.

Early in the search for this urgently needed material, the technicians who worked out this development found that, regardless of the resin, certain Navy requirements could not be met if any appreciable amount of organic reinforcement or filler was used. Presence of such reinforcement may result in a material that gives off highly toxic fumes under conditions such as those which were likely to be encountered aboard ship. A solution was found when inorganic, incombustible glass-fiber cloth and asbestos fibers were used in combination with fire-resistant resins.

In addition to possessing high fire-resistance, the new panel-board material has high impact strength and high resistance to the carbonizing effect of the electric arc—a condition that occurs when current jumps, or arcs, from one terminal to another across the panel board. Severe arcing can itself be responsible for panel-board fires which, if they should destroy the electrical control system, would leave the ship completely out of control.

In Fig. 1 a girl worker applies a blow torch to a sheet of this fire-resistant plastic board. Only a slight carbonized spot shows where the torch flame was applied. The equally good resistance to fire of the asbestos-filled material is indicated in Fig. 2. The part shown in the worker's right hand, molded of the new material, shows only a slight carbonized spot where a blow-torch flame was applied. In contrast, the part in her left hand, molded from the plastic formerly used in this application, has cracks where the material caught fire.

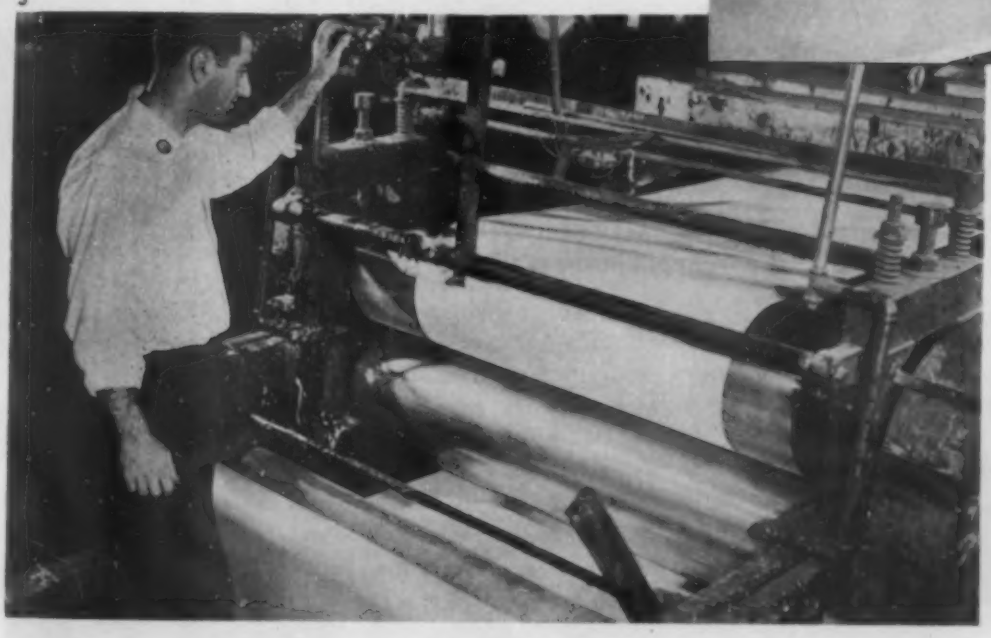
Because of the high modulus of elasticity of the glass-fiber melamine-resin laminate, shock to the panel board is readily transmitted to the instruments mounted on the board. This made necessary the development of new, shock-absorbing methods of mounting the (*Please turn to page 214*)

ALL PHOTOS, COURTESY GENERAL ELECTRIC CO.

5

4

3



***3**—The glass cloth, which is used as the filler for the flame-resistant laminate, is passed through a bath of varnish prior to its incorporation in the new plastic. **4**—A water-cooled diamond-edge copper wheel saw is used to cut and trim the flame-resistant laminated material. **5**—Upon completion, the material undergoes strict inspection by the Navy*

Molded machete sheaths

1

2

THANKS to the success of an exceptionally difficult injection molding undertaking, the Army Air Forces now have sheaths for their 18-in. utility machetes capable of withstanding the deadly action of tropical weather which has been known to deteriorate leather or canvas sheaths in as little as 72 hours. The new sheath is molded in one piece of cellulose acetate butyrate. Its extreme length of $18^1/_4$ in. made it particularly hard to draw out, yet this was done with a draft of but one one-thousandth per inch compared with a normal draft for similar jobs of two to three thousandths per inch. To accomplish this, an air cylinder operating a side core was used.

The plugs supporting this side core left four holes along the lengths of the sheath, and these holes serve as ventilators to prevent the collection of moisture which would rust the blade of the machete. The sheath is approximately $2^1/_2$ in. in width and the end has a rounded taper that fits the end of the machete blade. Side walls are slightly less than $^1/_8$ in. in thickness, and the width of the opening into which the machete fits is approximately $^5/_{16}$ in. at its widest point—tapering to a point at one end of the sheath bottom and rounded at the other.

A bracket at one end of the sheath supports a wire hook for fastening on AAF belts. The side core of the die molds the holes in this bracket, and the wire is put through and formed after molding. The entire sheath, including bracket, is, of course, molded in one piece.

So that the sheath will not gleam or show a glint in the sunlight, the die has a matte finish. The sheath itself is a dull olive green, the natural color of the material, except for the AAF insignia—a circle about 1 in. in diameter—which has a glossy finish.

Not only is the machete a most destructive close-range weapon but it is particularly effective in cutting through tropical jungles and for a multitude of similar jobs. With the development of the plastic sheath, the machete is, for the first time, given protection when not in use. It is reported that these new cellulose acetate butyrate sheaths will be used, from now on, to supplement those made of canvas or leather which were formerly the universally accepted materials for these machete cases.

Credits—Material: Tenite II. Molded by Cruver Mfg. Co. for Sears, Roebuck and Co. for Army Air Forces

1—*The injection-molded cellulose acetate butyrate sheaths presently used for the Army Air Forces' 18-in. utility machetes are capable of withstanding the action of tropical weather which tends to deteriorate leather or canvas sheaths.* **2**—*Holes left during the molding operation by the plugs, which support the side core, serve as ventilators to prevent the collection of moisture. A bracket at one end of the sheath supports a wire hook by which the machete and sheath are fastened on AAF belts*

Conference of Canadian Section

SOCIETY OF THE PLASTICS INDUSTRY

THE third annual conference of the Canadian Section, Society of the Plastics Industry, held at the Mount Royal Hotel in Montreal on Tuesday and Wednesday, Feb. 6 and 7, was attended by nearly 400 molders, extruders, fabricators, material suppliers and representatives of allied industries.

Lloyd J. Falkenhagen, general manager, Joseph Stokes Rubber Co., Ltd., was elected chairman of the Canadian Section for the coming year. John D. Benedito, sales manager, Canadian Resins and Chemicals Ltd., was elected vice-chairman and J. H. McCready, secretary-treasurer, Hale Brothers Ltd., was elected secretary.

In great part, the success of the convention can be attributed to the effort of the convention committee under the chairmanship of J. D. Benedito. Members of the committee were: J. H. McCready, who was in charge of speakers; J. C. Reid, Canadian General Electric Co., Ltd., in charge of hotel arrangements; L. C. MacLeod, Monsanto (Canada) Ltd., in charge of reservations; E. G. MacPherson, Dominion Rubber Co., Ltd., in charge of publicity; B. F. Henden and Spalding Black, Canadian Industries Ltd., in charge of printing; N. A. Austin, The Miner Rubber Co., Ltd., and W. D. Hinkhouse, Bolta Plastics Ltd., in charge of the reception.

Chairman of the opening session was K. H. Braithwaite of Duplate Canada Ltd., retiring chairman of the Canadian Section of the Society. J. H. McCready acted as chairman at the luncheon on Feb. 6 which was addressed by J. Lance Rumble, General Motors of Canada Ltd., who has been serving as Technical Adviser to the Commanding General of the Northwest Service Command. The subject of the speech was "The Alaska Highway." The first afternoon session was presided over by E. G. MacPherson while A. E. Byrne, Canadian General Electric Co., Ltd., past chairman of the Canadian Section, was chairman at the dinner meeting that followed. George K. Scribner, president of the S.P.I., addressed the meeting on the opening night as did J. Lance Rumble.

I. D. Wintrob, M. Wintrob and Sons, Ltd., was chairman at the Wednesday morning meeting, and L. J. Falkenhagen presided over the luncheon session. J. C. Reid, Canadian General Electric Co., Ltd., was chairman of the afternoon session on Feb. 7. Wm. T. Cruse, executive vice-president of the S.P.I., reviewed the Society's activities during the past year. The elections followed, with the results announced in the early part of this report. Three motion pictures, "The Shape of Things to Come," "Sight-Seeing at Home" and "Proving Ground" were presented later in the afternoon. K. H. Braithwaite was chairman at dinner the second night when Lt. Christopher Ellis, R.C.N.V.R., Special Services Officer, told the story of the work of Canada's navy in convoying vital supplies.

Post-formed laminates

J. ROGER WHITE, vice-president in charge of sales, Formica Insulation Co.

As the result of a process developed by W. I. Beach of North American Aviation Inc., products can be made of fabric-base laminated sheets by post-forming. However, to date this method is fairly well restricted to aircraft parts.

The material is heated rapidly to a temperature where it has no inherent stiffness. Then it is subjected to deforming forces and allowed to cool in its new shape. Phenolic-type laminates known as NEMA Grade C material are suitable — a fabric base being preferable to a paper base. Certain modifications of the resin binder and of the fabric base have been found to increase the degree of formability and to permit the working time to be lengthened.

The amount of crimp in the cotton fabric base determines not only the formability but the physical properties of the material and, for this reason, must be rigidly controlled. Fabrics normally used in Grade C material have 10 to 12 percent crimp in either direction with no balance of distribution. However, crimp can now be controlled in amount and in distribution in either direction of the fabric.

The phenolic-type resins used in these sheets have been improved to a point where: 1) the working range between minimum heating time and blistering point has been increased 50 percent; 2) the working range in time, from removal of the heating medium to completion of forming operation has been increased 40 percent; and 3) the depth of draw for a spherical cup has been increased 25 percent. These improvements were made by modification of the manufacturing process without undercuring the material or adding thermoplastic constituents, thus maintaining NEMA Grade C strength requirements.

Heating can be done by the infrared process, by circulating and non-circulating hot air, by contact with a hot plate or by immersion in a heated liquid. Operating time and temperature varies for each thickness and each heating medium so as to give maximum pliability without causing surface blistering. Shaping can sometimes be done in jigs or molds that have been made for forming aluminum or sheet metal. However, this is not usually true. All that is really needed to form these sheets is good hard wood stock, an assortment of hinges and fasteners and a lot of ingenuity. Male and female dies of wood can be so fastened that they will have leverage to bend the material. (*Please turn to next page*)

Drawing operations are similar to those used in drawing metal in that a hold-down plate and a positive means of controlling pressure are needed. Hardwood, metal, plastic materials, plastics-impregnated wood and compositions have been used in making the forming and drawing tools. For simple bending, hand pressure is sufficient. For drawing thick sheet material, air-arbor presses or hydraulic presses are needed. If metal forming tools are used, they may be water cooled. If, however, the tools are of wood, it is wise to allow from 3 to 5 min. before opening the form.

To date, formed parts have been used mainly for non-structural or simple semi-structural applications due to the fact that the weight strength ratio is not high enough for structural application. However, the material does have the following advantages: it absorbs vibration; it is light in weight; it has chemical resistance; it is resilient and stiff, and resists denting; it is economically sound. Testing methods and apparatus have been developed for determining the ultimate stretch of a formed material in both directions and diagonally, for finding the maximum radius to which any given thickness of a stock will bend without rupture, and for determining drawability.

No government specifications covering forming material have been set up as yet, but those compiled by North American Aviation Inc. have some degree of acceptance. For the present it would seem best to employ the temperature which a manufacturer specifies as being the most favorable for his material and to measure the formability of the stock under that temperature.

To some extent the development of low-pressure laminating has been held up while aircraft manufacturers have been developing the post-forming process. When the bulk of the applications that lend themselves to post-forming has been served, interest will revert to low-pressure molding since the choice of materials is greater. But many uses for post-forming will be found outside the aircraft industry.

Experience of a molder in using electronic heat

J. D. McDonald, president, McDonald Manufacturing Co., and first chairman of the Pacific Coast Section, S.P.I.

To some extent, Canadian molders face the same problems as do the molders on the Pacific Coast of the United States in that they do not often get an opportunity to engineer jobs but do have to engineer methods — and handle this work in such a way that the jobs do not have to be individually engineered. Both groups will find something to interest them in electronic preheating which has its special field in the production of large parts and heavy sections.

In preheating and preconditioning thermosetting materials, electronic processes have a definite place, but different types of electrodes are needed to handle different cross-sections and shapes so that there will be uniform distribution of heat throughout the preform. A variety of conditions serve to create problems in preheating — volatilization, too short cures and weather conditions which affect the moisture content of the material — but it is certain that when you preheat for maximum moldability you get satisfactory results. Latitude in preheating is also necessary.

My experience indicates that one operator can be used on more than one press. When preheaters are used on more than one press — considering that each press takes different preforms — they will have to be equipped with automatic tuning to get the right frequency, and with a timer on each press. The main purpose of the preconditioning technique is to get every package charge to the molding machine in a uniform condition with volatilization finished, with no damp surfaces and with no gas pockets.

Less experienced labor can be used where electronic preheating is employed because more latitude in molding is possible. However, employees must be convinced that they can produce better work more easily using this equipment.

Plywood structures

R. Hiscocks, Structures Laboratory, Division of Mechanical Engineering, National Research Council of Canada.

As a result of the war-born increase in the use of wood as an engineering material, this material is being used with a new efficiency. Now the feeling is that wood should not be considered as a wartime substitute but a material with unlimited possibilities for structural application. Wood has always been easy to transport and to fabricate; it displays strength and stiffness properties superior to those of other materials of the same weight; it has always been in abundant supply; and the supply can be assured over the years.

However, in its natural state, wood has several deficiencies. It lacks uniformity from the strength standpoint and it absorbs moisture. Consequently, laminated wood — particularly plywood — is used to overcome these drawbacks while retaining the advantages of the basic material. "Laminated" wood is a term used to refer to two or more pieces of wood glued together with the grain of all layers roughly parallel. "Plywood" refers to a combination of three or more veneer sheets bonded together with the grain of alternate plies at right angles. Since practically all shrink and swelling of wood comes in a direction at right angles to the grain, this latter construction produces a very stable material. Strength and stiffness qualities of wood are thereby greatly improved.

In 1929, as a result of the experiments in England and in the United States with preformed and molded plywood construction for airplanes, Lockheed began to produce molded plywood fuselages employing the now familiar fluid-pressure idea. But the animal, vegetable and casein adhesives then available were an obstacle and, until modern adhesives were developed, plywood progress was nearly at a standstill. Recently, developments in synthetic adhesives have proceeded so rapidly that plywood has again come into its own. The adhesive makers are carefully providing pertinent data on their materials and the woodworkers are becoming sufficiently chemical-minded to use that data to good effect.

In the field of adhesives, the best known synthetic resins are in the phenol and urea formaldehyde families. However, melamine formaldehyde is being widely used and other resins, such as resorcinols, are attracting some attention. This paper will deal only with thermosetting resins — those in which the condensation reaction when once completed is irreversible and no subsequent softening occurs even if the product is heated until the wood chars.

Resin adhesives are most conveniently classified according to their curing temperature requirements; that is, high, medium and low temperature setting. It is important to remember that these terms are only relative.

Film glue is being used extensively in the production of flat plywood. It consists of a very fine tissue paper impregnated with a phenolic resin. While it has many practical advantages, it requires a bonding temperature of around 300°F., having no "gap-filling" qualities, and needs to be used with a

wood whose moisture content is kept to not more than 10 percent.

Liquid resins may be preferred in many cases, particularly where double curvatures are involved. For weathering resistance the high-temperature phenols are generally regarded as supreme, although accelerated tests indicate that the melamine resins are also excellent in this respect. Furthermore, for many applications the lower setting temperature requirements of the melamines may offset the higher cost of the material. In bag molding work the hot-press urea resins have gained favor because of weather resistance, low setting temperature, moderate cost, and lack of sensitivity to the moisture content of the wood veneer. Extenders can be added to ureas to reduce costs and other resins can be combined with them to increase weather resistance.

Low-temperature adhesives are those with setting temperatures in the 100 to 200°F. range — and many of the "cold setting" resins belong in this group. To set at moderate or room temperatures, these resins require the addition of a catalyst, and the necessity for some heat, even with the "cold press" resins, is now generally recognized.

Manufacturers now have a wide choice of wood for use as plies. The Canadian specifications cover 35 acceptable varieties while the Forest Products Laboratories have prepared systematic strength data on some 60 species. Each wood has its own characteristics. Choice of the wood for plies is made on scientific data, but it is well to remember that only in a few rare applications is a plywood structure ever loaded sufficiently to produce high stresses. Where the structural loading is large, a high-density wood may be best; where medium density and stiffness is required with lower cost, Douglas Fir might be used. A low-density material is to be preferred where a high ratio of stiffness to weight is required.

Possible combinations of other materials with wood in making "plywood" with certain desired qualities are numerous. Resin-impregnated glass cloth can be applied to improve abrasion resistance, or the wood can be impregnated for the same purpose. Asbestos sheets or thin metal can be bonded into the wood for greater fire resistance. Other materials can be bonded directly to a plywood core in the normal pressing operation so that production costs do not get out of line.

Blow molding of thermoplastics

James Bailey, vice-president and director of research, Plax Corp.

The molding of hollow articles by using fluid pressure, while an old art, has undergone radical development in recent years and now offers new and interesting fields for future development. There are three general methods: 1) the indirect method, in which an existing shape, such as a rod, sheet or tube is blanked out, reheated and blown to the final shape; 2) the diaphragm method, in which preforms are built up from pieces and blown to final shape behind a rubber diaphragm (this is "bag molding" and is not to be confused with "blow molding" as discussed in this paper); 3) the direct method, in which molding powder is made plastic, then formed into an appropriate intermediate shape and blown into the final shape in a rapid sequence of operations. The objective of the first is to change, modify or refine the shape of some stock item. The objective of the second is the same, with the added requirement that better distribution must be obtained. The objective of the third is to produce items by low-cost, mass-production methods. In all, the plastic must be made soft and stretchable by the application of heat and solvent, then formed to shape and solidified against the mold, then removed from the mold and, frequently, trimmed and finished.

In older forms of blow molding, hot molds had to be used. This took time, and there was always danger of warpage of expensive molds if cycles were pushed up to the limit. Modern high-production cycles use hot plastics and cool molds. The rubber-diaphragm method is avoided wherever possible on thin, low-cost articles since the diaphragms do not stand up very well and the cycle is much longer. However, the method is useful in forming large, heavy-gage sheets.

The third, or direct, method is a mass-production process and is applicable to articles of the general character of bottles, although such large-scale items as Christmas tree balls, toilet floats, etc., have been made with it. In some cases it is not possible to get as good an appearance with this method as can be obtained by making the items from sheet stock since the distribution of wall thickness is not so perfect, but the articles are made cheaply and easily.

There are three major steps in the process: 1) softening the plastics; 2) forming a blank or parison; 3) blowing the parison to final shape. The exact procedure in any case is dependent upon the complicity of the object to be blown and the final result may be accomplished by a great many methods. A full description of the various methods will appear in an early issue of Modern Plastics.

Residual stress in formed methacrylate sheeting

Dr. R. Richardson, Duplate Canada Ltd.

In the measure that plastics duplicate the hardness and transparency of glass, they have also to some degree duplicated the conchoidal fracture and brittleness of glass. Duplate Canada Ltd., supplying formed methacrylate sheeting to the aircraft industry, followed its components into the various ships and its research men studied the engineering causes of some loss of material and labor through breakage of formed plastic sheeting during and after installation.

One glass-bottle manufacturer who resolved to remove all stress from his bottles, installed an expensive lehr system with control stress analysis instruments. He finally produced a bottle that disturbed the polariscope not one iota — but breakage reports increased. Today more is known about the principles of "heat" or "stress" toughened glass which caused his disappointment. And there is every reason to believe that plastics follow some of these "laws." This paper is a moderate plea that the annealing of complete aircraft canopies be given at least one semi-commercial trial on a scale not possible in a laboratory.

A case of residual stress was referred to the laboratory when breakage in service seemed high. Polariscope examination of the canopy as formed showed that residual stress was present near some small radii bends. It was found that additional stress was imposed on the part during installation, mostly at bolt holes, etc. A canopy shape correction was also indicated and recommended. However, since time was short, the immediate solution was to increase the radii of curvature slightly and when this was done breakage reports dropped off.

Attempts to anneal this part on the form were not successful. It was obvious that the annealing would have to take place off the forms or after the presses. A number of heating cycles were worked out and filed, but they were never used for the following reasons: 1) the design change that was

effected to reduce the residual stress in the particular part that was first seriously involved proved to be a practical solution; 2) the cycles that were developed required several days for completion; 3) the cycle temperatures were dangerously near the deforming temperatures; 4) annealing after forming but before drilling would have little beneficial effect on the stress imposed by drilling, rabbiting and bolting the sheets to the forms. It also become apparent that these stresses were residual and remained for some time after working as a potential source of breakage.

In another case where stress cropped up in a small molded part it was found that there existed a relation between the causes of crazing in methacrylate sheeting and the large stresses visualized by the polariscope during the preceding work. The following stress classification expresses this relationship viewpoint:

Type one — internal stresses. They are thought of as being set up during forming (sheeting) or flowing (molding), and are visualized readily by a standard polariscope using poleroid film. Generally, they can be removed by annealing, using a relatively high temperature with a slow cooling cycle. The presence or absence of this type of stress is not indicated by surface etching.

Type two — surface stresses. These stresses are the cause of crazing and are peculiarly related to the surface since surface etching of the material will disclose their presence or absence. Annealing cycles for them do not require a long cooling period such as an internal condition would indicate.

Type three — intermediate stresses — These show up by both polariscope and surface etching. The antidote annealing treatment used in removing them is intermediate in the time that is consumed and the intensity that is required. Work stresses produced during and remaining after the drilling of a hole are examples.

Synthetic rubbers and resins in cable industry

H. Douglas Short, Canada Wire and Cable Co., Ltd.

The manufacture of electric cables involves not only electrical engineering, but metallurgy, chemistry and physics. An old theory that the prime purpose of the insulant around the cylindrical conductor in a cable was to prevent "escape" of electric charge from the conductor has long since been discarded. Now engineers know that the chief function of the insulant is not to form a barrier against loss of charge, but to present a medium by means of which the transfer of energy along the copper conductor is efficiently effected.

All transference of energy, whether mechanical (as in a hydraulic system) or electrical, is accomplished by setting up a strain or pressure at the source of supply and by releasing that strain at the other end where the energy is expended on the work to be done. In the case of hydraulic transference of energy, the shaft receives the strain; in electrical energy transmission the strain is on the insulation.

In electrical transmission there must be: 1) an electric field between the conductors and 2) a magnetic field around the conductors. The insulation must have an atomic structure capable of withstanding disintegration by the energy stored and under strain in the electrical field. But insulation requires certain physical properties in addition to its electrical properties, and these are dependent on its chemical composition. Tensile and compressive strengths, brittleness, flexibility and ageing resistance are all to be considered.

Insulation for conductors has been made from cotton and silk yarns, paper, bitumen, natural oils, gutta percha, resin, amber and rubber, used in various adaptations and combinations. These were all natural plastics. Loss of natural rubber sources after Pearl Harbor led to the development of synthetic plastic insulations with a wide range of properties and uses. Plastic materials used during recent years are:

Neoprene — It is used chiefly for outside cable sheathing. Because it contains the halogen atom — chlorine — it has poor electrical properties, although this gives it a fire-resisting quality and makes it immune to oil and sunlight.

Buna-s — It is quite similar to natural rubber and, except for some very special work, is widely used as an insulator in compounds. It is flexible and, therefore, most adaptable to use on household cables.

Koroseal, Geon, Vinylite — Under these trade names the resins resulting from the plasticization of polyvinyl chloride and the copolymer vinyl chloride and vinyl acetate are widely used as cable insulation. However, they must be combined with suitable plasticizers. They are only fair as insulants but have superior chemical and physical properties.

Polyethylene — This is a promising insulating plastic and a true plastic — unlike the polyvinyl chlorides. It possesses exceptional dielectric properties at all temperatures and frequencies, making it useful in radio, television and high voltage transmission work.

Plastics serving in the war effort

W. J. Connelly, manager, Consumer Relations Div., Bakelite Corp.

The war brought many changes in production, design and research in the plastics field. Since Canada entered the conflict before the United States, the whole continent and the United Nations benefited by various Canadian plastics developments. This paper discusses plastics developments with particular reference to the materials our company produces.

The new technique of heatronic or high-frequency molding involves the heating of a thermosetting molding material in a high-frequency electrostatic field. The molding material, heated throughout its mass to about molding temperature, is then transferred to a heated mold and the material molded in compression molding equipment. Beginning in 1926, transfer molding has contributed many fine plastic applications which today are of vital importance in the war effort.

The bonding of densified wood with special thermosetting resin glue has made possible our new airplane propellers, and the same plywood techniques are being used generally in airplane manufacture. Vinyl compounds insulate the power lines of our warships and merchant ships. Non-oxidizing and long looked upon as a replacement rather than a substitute for rubber, wire and cable insulation is the largest single application of vinyl in this war.

Low-pressure laminating molding had come along to provide new applications. Batts, strips or sheets of fibrous cellulose, glass or asbestos impregnated with thermosetting resins are formed at low pressure in several ways and make possible new uses for these materials. Thermosetting ester-type resins for very low-pressure molding, post-forming of high-pressure laminates, elastomeric-molded applications of vinyl chloride-acetate copolymers in elastic plastics, the high pressure synthesis of polyethylene, a new cold-setting phenolic resin for bonding plywoods, and a new low-loss phenolic molding material for insulation — the summary is incomplete, but these mentioned are at least of most interest.

PLASTICS*
Engineering Section
F. B. STANLEY, Editor

Steam generator for individual presses

AFTER several years of development work a somewhat radical electric steam generator has been adapted to plastics presses, which gives indications of affecting compression molding, by equipping each press with an individual boiler, in much the same way that industry was influenced several years ago when a separate electric motor on each machine replaced the central power plant.

The history of this equipment goes back to 1939 when a Boston man, Stanley Livingstone, worked out a method of financing new enterprise so that this traditionally dangerous activity became more attractive and less hazardous. The first step was the organization of a group of prominent individuals, interested in making venture capital investments. The services of advisers were obtained and the door thrown open to anyone seeking backing for a new enterprise. No commissions were charged; the sole criterion was merit. No idea was considered unless it showed promise of accomplishing something important and doing it better and cheaper than any other device or system already in the field.

Out of literally hundreds of projects submitted for consideration, three were selected. Two have already been spectacularly successful and the third bids fair to outstrip both the others. This third development is the electric steam generator which gives such indication of success that some of the plastics molders who have cooperated in its development are considering a change-over from a central boiler to an individual generator on each of these presses.

In the 1930's Ralph W. Vickery, an electrical contractor with an inventive flair, wanted to mold some thermosetting material. Since electricity was for him the handiest source of heat with which to generate steam, Mr. Vickery built a generator on the egg-cooker principle, that is he worked out a unit consisting basically of two pipes immersed in water that was made to boil by the passage of electric current. This arrangement had the advantage of possessing no coils or heating elements that might burn out.

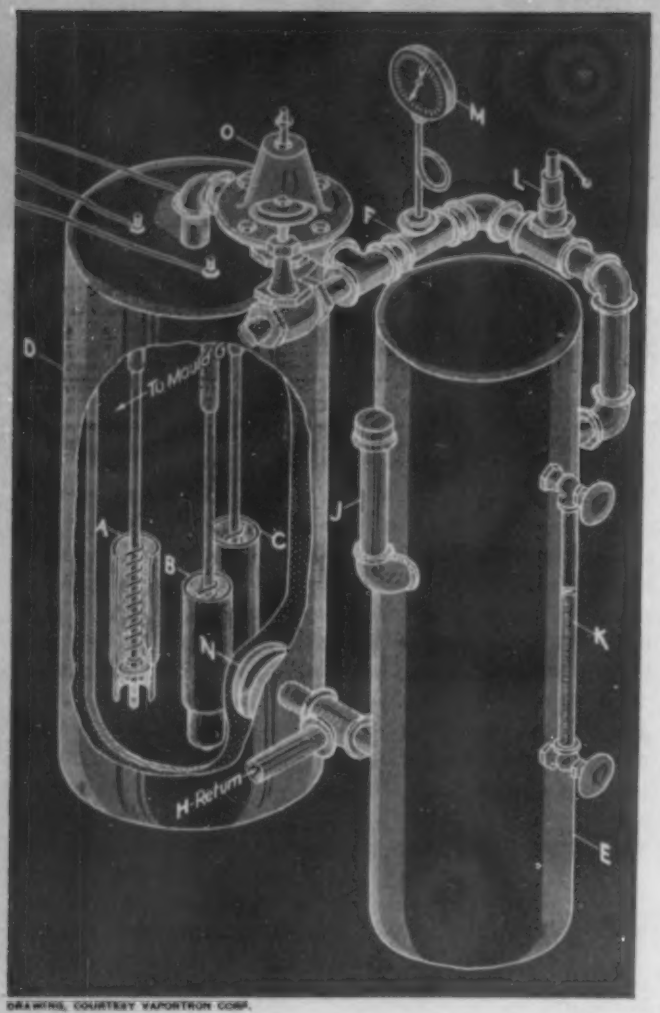
Mr. Vickery then figured out an equally simple method of controlling the steam pressure without a thermostat, switch or any other device. In this type of unit, the speed with which steam is generated is in direct proportion to the rate at which current is drawn; and the rate at which current is drawn is in direct proportion to the extent to which the electrodes are covered with water. Thus, in an egg cooker, when the water has boiled away there is nothing to carry current from one electrode to the other. Consequently, the heating operation stops.

Ralph Vickery employed this same principle in his closed-pressure system by connecting his electrode chamber to a separate chamber that served both as a water reservoir and a compression tank. The addition of air pressure to this secondary tank forced a certain amount of the water into the electrode chamber—partially filling it and covering the entire length of the electrodes. When, after the electrodes were connected to a source of electric power, steam was generated under pressure, the water in the electrode chamber was gradually pushed back into the pressure tank. This action built up a steadily increasing pressure against the air cushion. The gradual loss of water from the electrode chamber left more and more of the surface of the electrodes free from contact with the water. This had the effect of reducing the amount of current drawn by the unit and, in consequence, the amount of steam that was generated. With less steam in

1—*Experimental generator made up of pressure tank and electrode tank. This unit supplies steam to the mold. The only power connection that is necessary is a 3-wire hook-up to the electric power system in the plant*

PHOTO, COURTESY VAPORTRON CORP.

* Reg. U. S. Pat. Office.



DRAWING, COURTESY VAPORTRON CORP.

2—A cut-away isometric view of the steam generating unit. The identity of the letters is as follows: A, B and C are the 3 electrodes; D, the generating tank; E, the pressure tank; F, the steam line; G, the mold steam supply; H, the return line; J, the water fill; K, the water gage; L, the safety valve; M, the pressure gage; N, insulating flanges and O, pressure reducing valve

the electrode chamber, the motion of the water was reversed and the flow of water was once more from the pressure tank to the electrode chamber. This system controlled the steam pressure without the use of mechanical moving parts.

After securing patent protection on his apparatus, Ralph Vickery set out to conquer new worlds—domestic water heating, cooking, house heating and humidification—using low-pressure variations of this same principle. A long investigation of the generator and its probable uses, completed by Stanley Livingstone, was followed by the organization of the Vaportron Corp. and the formulation of plans to produce applications that had already proved successful in a number of home and industrial installations.

Then came Pearl Harbor. To insure the company of priorities essential to the production of this equipment, the steam generator was adapted for use in applications bearing on our wartime economy. Tire recapping presented a promising field inasmuch as the effects of an acute boiler shortage were being intensified in this industry by a substantial increase in mold installations. Consulting engineers were retained, the generator adapted for a range of demands, test models installed and, finally, a basic design selected that did the job for which it was intended and met the specifications of the A.S.M.E. boiler code and the Underwriters' Laboratories.

In attempting to appraise the usefulness of the generator to different industries, a survey was undertaken. Results indicated that the features of compactness and self regulation made the generator particularly well fitted for plastics molding in cases where different but specific steam pressures must be employed to meet the requirements of the particular plastic being molded.

The Vaportron Corp. discussed the matter with Hans H. Wanders, vice-president of Northern Industrial Chemical Co., who expressed the opinion—on the basis of a study of the design and successful experience with the unit in the molding of tires—that the generator would perform satisfactorily on a plastics press. So strong was Mr. Wanders' belief in the potentialities of heating each press individually, free of the time, location, pressure and capacity limitations of a central boiler, that he agreed to cooperate by installing and operating test models on a press.

Since the use of compressed air as a means of steam-pressure control appeared less suitable in plastics molding than tire recapping, a method was devised that employed self-generated steam and a pressure regulator that could be set for any pressure desired. Mr. Wanders and Thomas McNicholas, superintendent, collaborated in designing the successive models on the basis of operating reports and characteristics submitted by Steve Wright, the maintenance engineer who supervised the tests.

A model incorporating the third group of changes of this generator was installed on February 21, 1944. This unit ran 24 hours per day, 7 days per week at a constant pressure of 150 lb. without the addition of water, in fact without any attention whatsoever, until the parts' order then being molded was completed a little over one month later. Since then the steam generator has been used on various presses for varying lengths of time and always the use of the unit has met with equally satisfactory results.

A cut-away isometric view of this latest steam-generator unit is shown in Fig. 2. The operation of the system is roughly as follows: water in the steam-generating tank *D* completes the circuit between the three electrodes *A*, *B* and *C*, causing a certain amount of current to flow in the system. The amount of current that is drawn will vary in direct proportion to the depth to which the electrodes are immersed in water. A maximum flow of current will take place when the electrodes are completely covered but there will be no flow at all when the water level is below the bottom of the electrodes and, therefore, fails to make contact with them. This passage of current between the electrodes heats the water to the boiling point. The steam generated in this manner passes from the generating tank *D* through a pressure regulator *O*, and steam lines which lead to the pressure tank *E* and to the feed line to the mold platens *G*. The return line *H* is used to collect the condensate from the mold and return it to the boiler by gravity.

Generating steam in a closed system causes the pressure to rise. When it rises enough to lift the diaphragm valve in the pressure regulator *O*, the flow of steam through the regulator to pressure tank *E*, and to the feed lines to the mold platens is shut off. With the steam supply blocked by the regulator valve *O*, the pressure in tank *E* drops until it is less than that in the generating tank *D*. Of course, for a short space of time after the closing of the regulating valve, the pressure in tank *D* continues to increase. The higher pressure in *D* as compared with *E* causes the water level to drop in *D* by reason of the fact that pressure in *D* forces the water

out through the lower feed pipe into the pressure tank *E*. This action equalizes the pressure in the two tanks.

However, at the same time, the water in the steam generating tank *D* has dropped to a lower level on the electrodes —reducing the amount of current flowing through the water and, in consequence, the amount of steam that is generated. This sequence of events causes the steam pressure in *D* to drop still further until it reaches a point at which the regulator valve *O* reopens and allows steam to flow once more through the valve to the mold and to the pressure tank *E*. This comparative reduction in pressure in tank *D* permits the water to rise on the electrodes so that the amount of current passing through the water is once more increased and the steam pressure again begins to rise. As a matter of fact, in actual practice, the pressure shown by gage *M* which indicates the pressure in the feed line to the mold remains practically steady while the amount of current drawn by this unit fluctuates according to the actual steam demand which is controlled by the action of the regulator valve.

On the basis of the test conducted by Northern Industrial Chemical Co. and on a smaller trial test that was also entirely successful, the Vaportron Corp. wrote a number of plastics molders offering to place generators on a trial basis in order to determine, before settling upon a final design, what changes might be necessary. Mr. Murphy of Standard Plastics Co. and Mr. Burt and Mr. MacKay of Royal Moulding Co. cooperated extensively in these tests. Under the supervision of Mr. Casey, the Bolta Co. ran successful tests at well over 200 lb. steam pressure. All told, 18 generators were shipped to various points between Massachusetts and Missouri enabling the company to enjoy results from a wide range of mold sizes and operating demands.

Reports that a few performances were erratic or otherwise unsatisfactory caused the Vaportron Corp. to retain consulting engineers for the specific purpose of altering the generator to meet every requirement that might be encountered in compression molding. The principal change was the enlargement of the diameter of the electrode chamber so that, regardless of the size of the mold or the operation requirements, the steam could never move at a high enough velocity to carry slugs of water into the mold so as to block the steam circulation.

Through the kind offices of Mr. Penrod, Maryland Plastics, Inc., loaned the Vaportron Corp. a pair of platens, 26 × 22 × 1⅞ in., to facilitate shop tests. Mr. Wanders of the Northern Industrial Chemical Co. agreed to submit the new model to a difficult metered test and make the results available to the industry through MODERN PLASTICS magazine. Operating results are also reported by Standard Plastics Co. and the Royal Moulding Company.

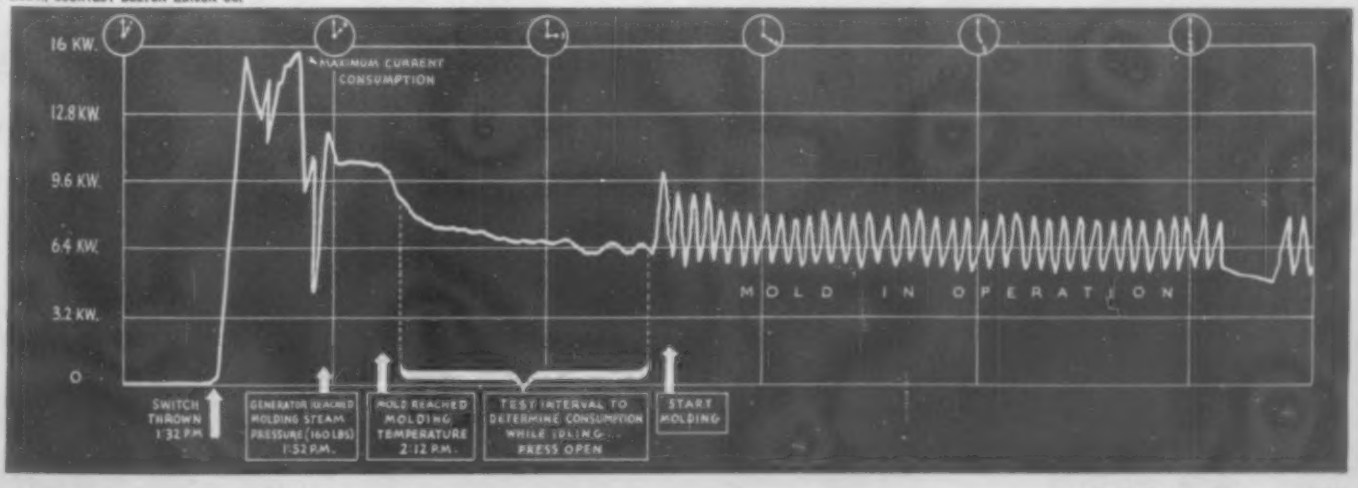
When the final steam-generator unit was completed and installed at Northern Industrial Chemical Co., a recording wattmeter was added so that a completely unbiased record would be available of the amount of power that this unit needed for normal operation. Figure 3 is a redrawn picture of this power consumption record annotated to show just what operations were in progress during the period from 1:00 p.m. until 6:00 p.m. of a normal day's molding.

When the switch was turned on at 1:30, an average power of approximately 15 kw. was consumed during the 15 or 20 min. that it took the unit to build up sufficient steam pressure (160 p.s.i.) for normal mold operation. Of course, even when the steam pressure reached 160 lb., the mold itself had not yet had time to absorb enough heat to bring it up to the normal molding temperature. At the end of approximately 40 min., however, the mold reached molding temperature. It was allowed to remain idle for about one hour to determine the current consumption of an idle mold. As can be seen from the chart (Fig. 3), this power averaged about 7 kw. At approximately 3:30, the mold was put in production. According to Fig. 3, the molder averaged 13 shots per hour. During this time the power consumption varied from about 6 to 8 kilowatts. The greater load was drawn when the cold material was first loaded in the mold, dropping off as the cure of the plastic proceeded.

Examination of this record showed the average power consumption for this press to be 7 kw. per hour. A check upon the average power costs in several parts of the country indicated that 1 cent per kw.-hr. was a fair average for electrical power costs. This would indicate that the cost of power to generate the steam for this 150-ton press was in the neighborhood of 7 cents per hour. The higher power necessary to heat the cold mold need not be taken into account at this time inasmuch as a direct comparison will only take into account the costs of power after the mold had been heated up. It is axiomatic that (*Please turn to page 200*)

3—*Actual record of power consumption made by a recording watt-hour meter while installed in the power line of one of these generators. Each valley shown in the zigzag line from approximately 3:30 until 6:00 indicates the precise instant that the material is loaded into the mold. The time interval from valley to valley indicates the length of time required for one complete cycle*

GRAPH, COURTESY BOSTON EDISON CO.



OFFICIAL U. S. NAVY PHOTO

PHOTOS, COURTESY SPERRY GYROSCOPE CO., INC.

1

1—For safety from attack by enemy planes, Navy ships not only must be equipped with an overwhelming complement of anti-aircraft guns but these guns must have proper fire-directing instruments. Today, the chassis covers of Navy gun directors are made of plastic

Boosting the box score

ON a fateful morning shortly after Pear Harbor, the Prince of Wales and Repulse were steaming through the China Sea, disregarding all risks in their determination to knock out a huge Japanese convoy bound for Malaya. These giant ships were equipped with the latest anti-aircraft defense and, in consequence, considered reasonab y safe from air attack. Their destroyer screen gave them adequate protection from undersea attack. Nevertheless, the seemingly impossible happened. These two majestic ships were attacked by wave after wave of Japanese torpedo bombers, and sunk. Admitting that the destruction of these two ships was keenly felt, the greatest blow to the British was their loss of prestige. No longer could Britain consider herself mistress of the seas in that particular area.

For many years there had been great agitation against 30,000-ton and 40,000-ton battlewagons. The critics stated that they were entirely too vulnerable, not only to submarine and destroyer attack, but to sustained attack from the air—especially if such attacks were from torpedo planes. Immediately after the sinking of the Prince of Wales and the Repulse, the hue and cry against large unwieldy battleships was increased. Greatly to the credit of our top Naval men, they were not swayed in any manner by this battle of the critics. Instead of discarding plans for new battleships, they turned their attention to making these ships as nearly invulnerable to air attack as possible.

Of course, there is really only one way to make a ship safe from air attack—and that is to equip it with sufficient anti-aircraft fire power so that the attacking planes are destroyed before they can press home their attack. To do this, not only must a ship mount sufficient guns to create an impenetrable curtain of fire, but these guns must be equipped with the proper fire-directing instruments.

The Prince of Wales and the Repulse, as well as many of our own ships sunk at Pearl Harbor, were equipped with anti-aircraft guns of the latest design, but the gun-directing equipment was not equal to the task presented by the high speed and maneuverability of the attacking planes. However,

times have changed. The box scores made by our anti-aircraft gunners have shown a steady improvement until today a wide area around each battlewagon is unhealthy territory for enemy planes.

Even compared to the much-publicized bombsight, the Naval anti-aircraft gun director is an instrument of unbelievable complexity. Although the details of these directors cannot be revealed, the important part that plastics materials have played in simplifying the construction of the apparatus, reducing its weight and adding to the workable qualities of its mechanism, is open to description.

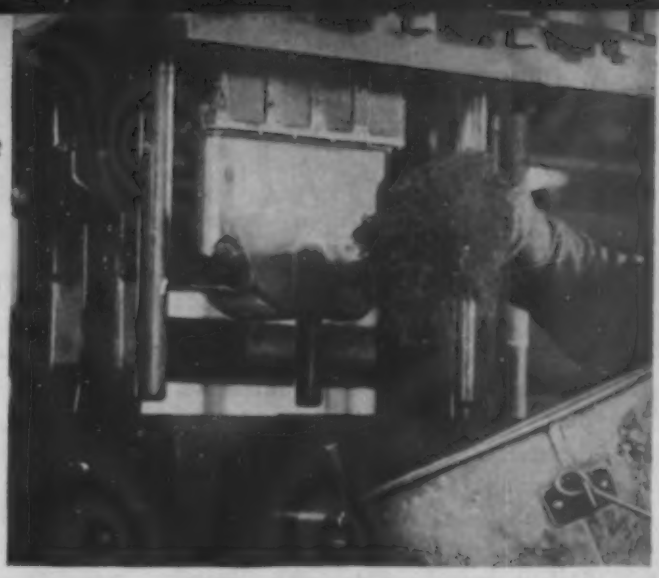
The chassis cover is probably the most important part of the gun director to be made of plastics. When this director was first produced, aluminum was used for both the chassis and the cover. In a general production redesign of the instrument, it was decided to use a plastic cover to save critical aluminum and reduce machinery operation time. As is often the case when companies start out to convert a metal item to plastics with such objectives in mind, this firm discovered that it not only saved time and critical material but produced a better part.

In this particular case, the aluminum cover weighed more than 8 lb. whereas the finished plastic part, complete with two brass inserts, weighs but four. Complete insulation of the mechanism which the design of this gun director demanded, was achieved in the aluminum housed unit by lining the inner surface with felt pads. Great care had to be taken in this operation to make certain that the cork did not flake, inasmuch as even a few tiny particles of this material would be enough to upset the accuracy of the instrument. With the change to plastic, felt insulation was no longer necessary—removing one of the principal factors responsible for inaccurate operation.

When the cover was made from aluminum, many machining operations had to be performed on the rough sand casting before it was ready for assembly. An error in any one of these operations would, of course, produce a rejected part. Although the plastic cover as it emerged from the mold is not entirely ready for use, the only operation which the Sperry Gyroscope Company, Inc., is called upon to perform is the spraying of the part with Navy lacquer. This coating is applied only in the interest of color.

This plastic gun-director cover, approximately 12 by 12 by 10 in., with many compound curves and rectangular and round openings (Fig. 1), presented quite a serious problem for the mold makers who finally selected a completely positive-type mold for the job. In this setup, automatic cams operate plugs which mold a 3 $^{7}/_{32}$-in. (*Please turn to page 194*)

2



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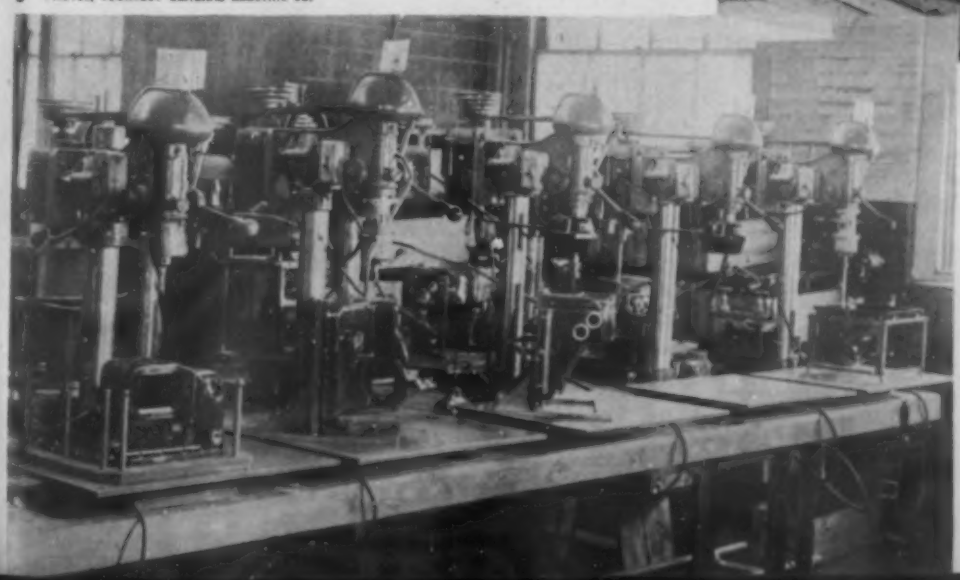
5 PHOTOS, COURTESY GENERAL ELECTRIC CO.



2—The phenolic material is loaded into the mold by hand. 3—Before the mold can be opened, threaded insert pins are unscrewed. 4—Upon removal from the mold, the cover is clamped into position on the shrink block. 5—Drill jigs are used for drilling and tapping

plastic materials for

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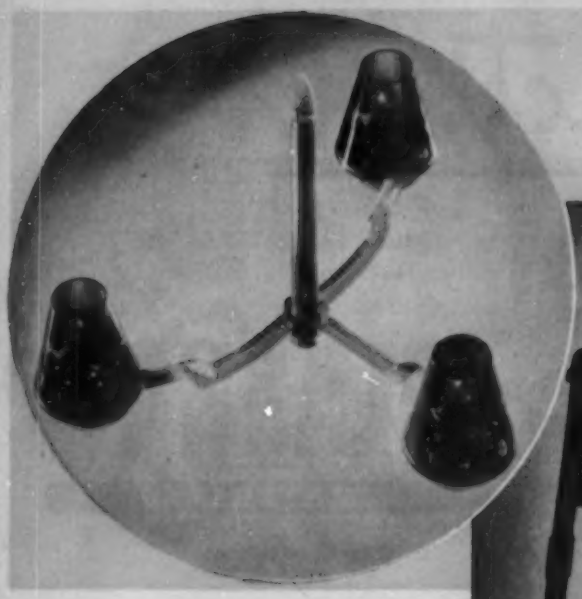
A new mold for the M-52 fuze



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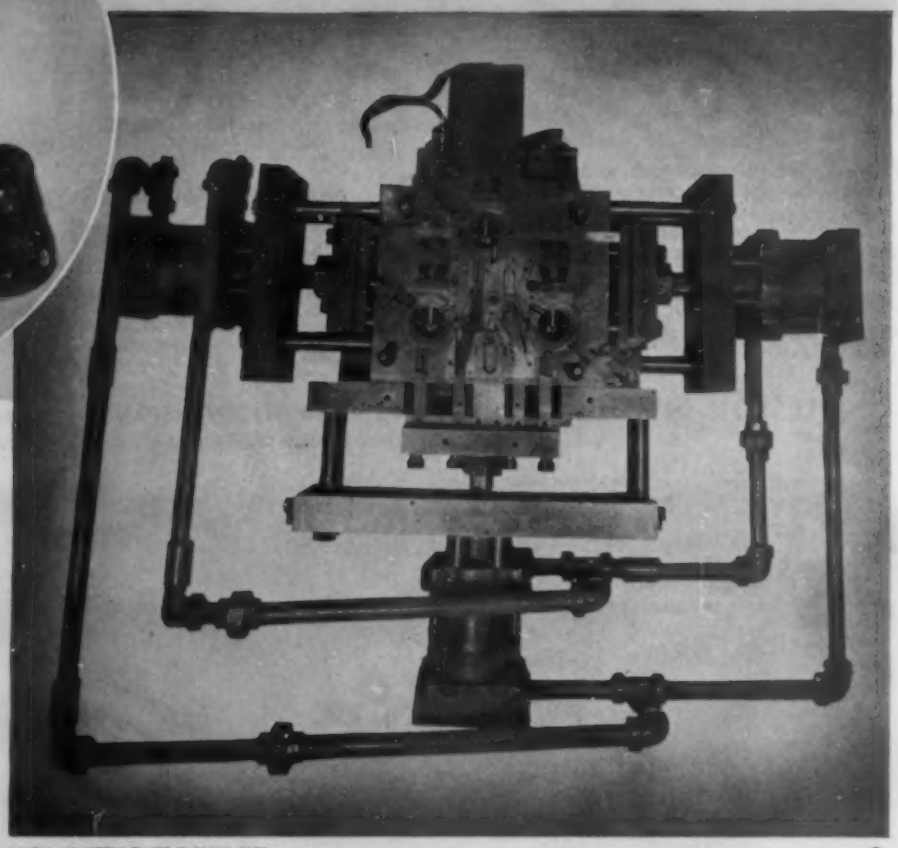


PHOTOS, COURTESY ELMER E. MILLS CORP.

2

1—Three of these thermoplastic M-52 fuzes are turned out simultaneously by this new mold. 2—This view of the stationary half of the mold shows the arrangement of the hydraulic pipes and lines. For photographic purposes the mold was moved from its usual position. This explains the unattached wiring evident at the top of this figure and at the top of Fig. 3

OUT of the Army's need for more and still more fuzes for one of its deadliest weapons—the trench mortar—has come a new plastic mold, entirely automatic, intricate but compact, that represents a definite departure from the conventional in the field of injection molding of thermoplastic materials.

No mold like this one has ever before been developed. Yet it has demonstrated its ability to produce, in quantity, complicated shapes having close tolerances and to mold these products so that they pass rigid inspection and difficult tests. The mold's unusual design and construction are obvious at first glance. There are more than 200 moving parts, each one strong enough to withstand a normal molding pressure of 20,000 p.s.i. without distortion, and all of them contained in a body that has a face only 13 by 15 in. and a depth of 12 inches. These measurements do not take into account the hydraulic cylinders, motors and controls.

The computed capacity of 30,000 fuzes per month made possible by this new method takes on added weight when it is realized that the mold was perfected for the production of the widely discussed Army M-52 trench mortar fuze. The new fuzes thus produced have been made of a special ethyl cellulose material.

When the decision was made to proceed with the development of the new method, little time was allowed for the usual design alterations and refinements. Within 24 hours of the time small sketches had shown the feasibility of the project, the maker ordered steel for the molds, and within 48 hours the company had the steel in its lathes. From then on, it was a question of step-by-step development toward a mold that would produce not one, but three M-52 trench mortar fuzes simultaneously.

The fuzes in production at the time the mold was undertaken (the Army has since followed a program of continuously perfecting the fuze) had an over-all length of approximately $2^1/_2$ in. with a truncated conical section about 2 in. long. The base diameter was $1^{15}/_{16}$ in. and the top diameter $^{31}/_{32}$ in. (all dimensions approximate). Protruding from the base of the cone was a boss, $^1/_2$ in. long, threaded inside and outside. This boss had an outside diameter of $1^1/_2$ in. and an inside diameter of $1^1/_8$ in. There were four holes extending upward from the base of the conical section, and seven radial holes extending from five different directions into this section. Of the seven holes, one is threaded and another telescoped through one of the holes coming up through the base. Still another was stepped and entered axially through the small end of the cone, opening into the threaded hole and two of the radial holes.

Basic design problems

The problem of designing the mold to produce such a piece immediately resolved itself into two basic technical considerations. The first of these was geometric—there were dozens of parts moving in the same plane, but in different directions. The next was a problem of sequence—in the mold, certain parts had to move so as to be clear of other

parts as they moved through the same spot. Certain cores telescoping through each other at right angles to other cores meant that one core must be completely out of the way before another core could be moved. The problem was further complicated by the fact that in the closing of the mold an entirely different sequence of movement was necessary.

It was obvious that the parting of the mold would come at the large diameter of the conical piece. Thus, the conical portion of the piece would be on one half of the mold and the cylindrical portion, which is threaded inside and out, would be on the other.

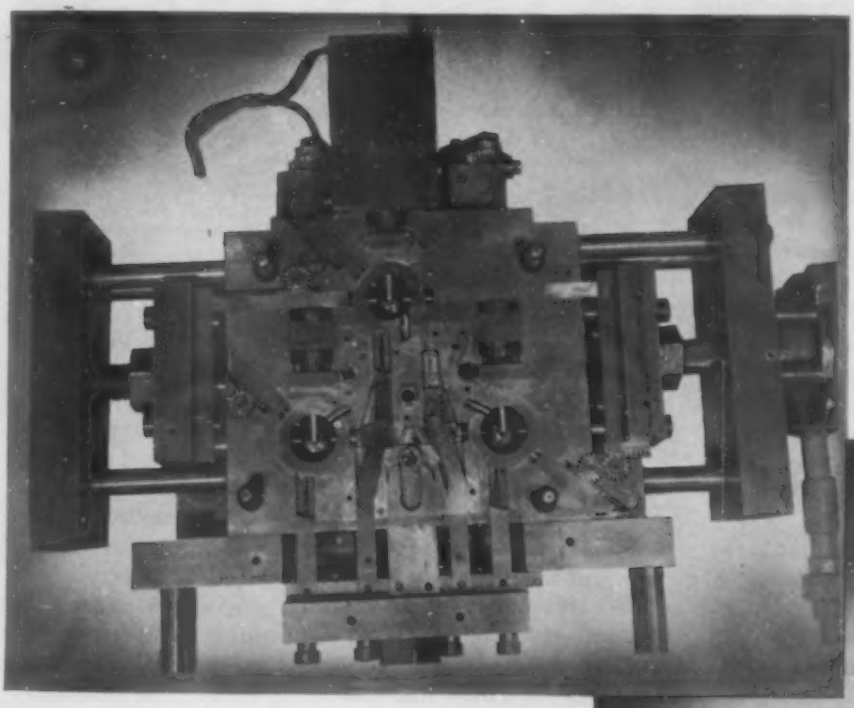
It was agreed to kill two birds with one stone by making a mechanism that would mold the threaded section of the cylinder section of the fuze and eject the entire piece as the threaded sections of the mold revolved. This decision automatically put the conical cavities in the so-called stationary section of the mold. And this meant that all of the side pulls necessary to form the various radial holes must be moved before the mold started to open.

Methods of pulling the side cores were then laid out. In this connection it should again be noted that there are seven side cores to be pulled in five different directions from each of three castings before the mold can start to open. Since one of the seven cores is threaded, it was necessary to revolve this core as it was pulled from the casting.

Several plans were considered. One was to have each casting on a different plane so the various cores would not interfere with each other while moving. The designers endeavored to avoid this arrangement because they believed it to be poor molding practice to have several cavities at different distances from the sprue. They agreed that, in order to get uniform molding characteristics, it was desirable to have all the cavities on one plane, positioned equidistant from the sprue.

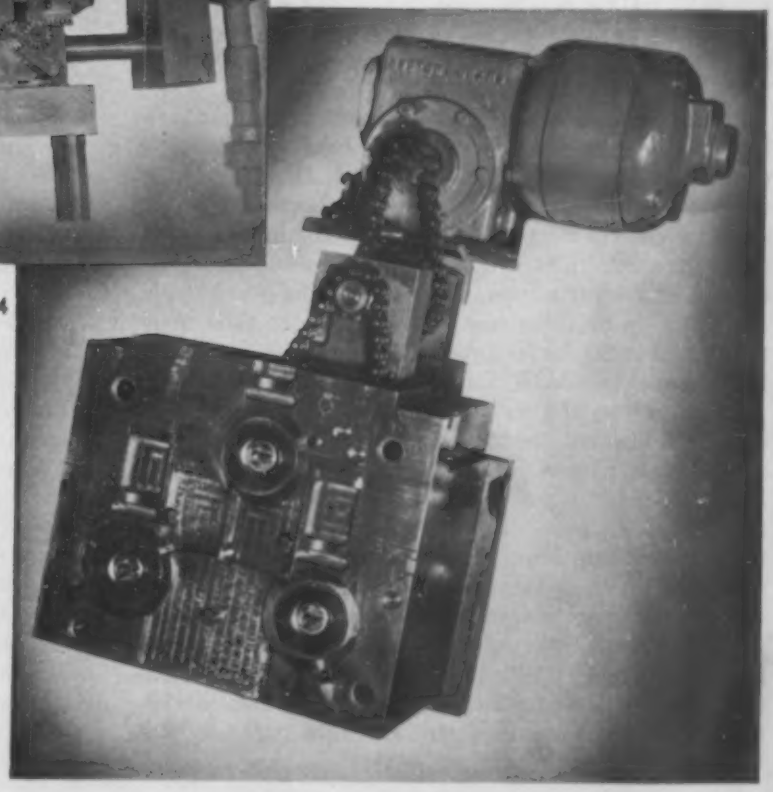
Finally, all cavities were laid out in a triangular pattern, each one at the corner of an equilateral triangle with the threaded hole along the vertical axis so it could be pulled by an upward rotary action. This left six holes to be pulled in each cavity: four holes horizontally—two from the left and two from the right—one long thin hole a comparatively long distance in a downward direction and one hole at about a 30° angle from the vertical threaded hole.

Three hydraulic cylinders—to be used left, right and downward—were chosen as the source of motion. Since the downward pull was a comparatively long one, a cam action—deriving motion from its movement—was used to pull in-



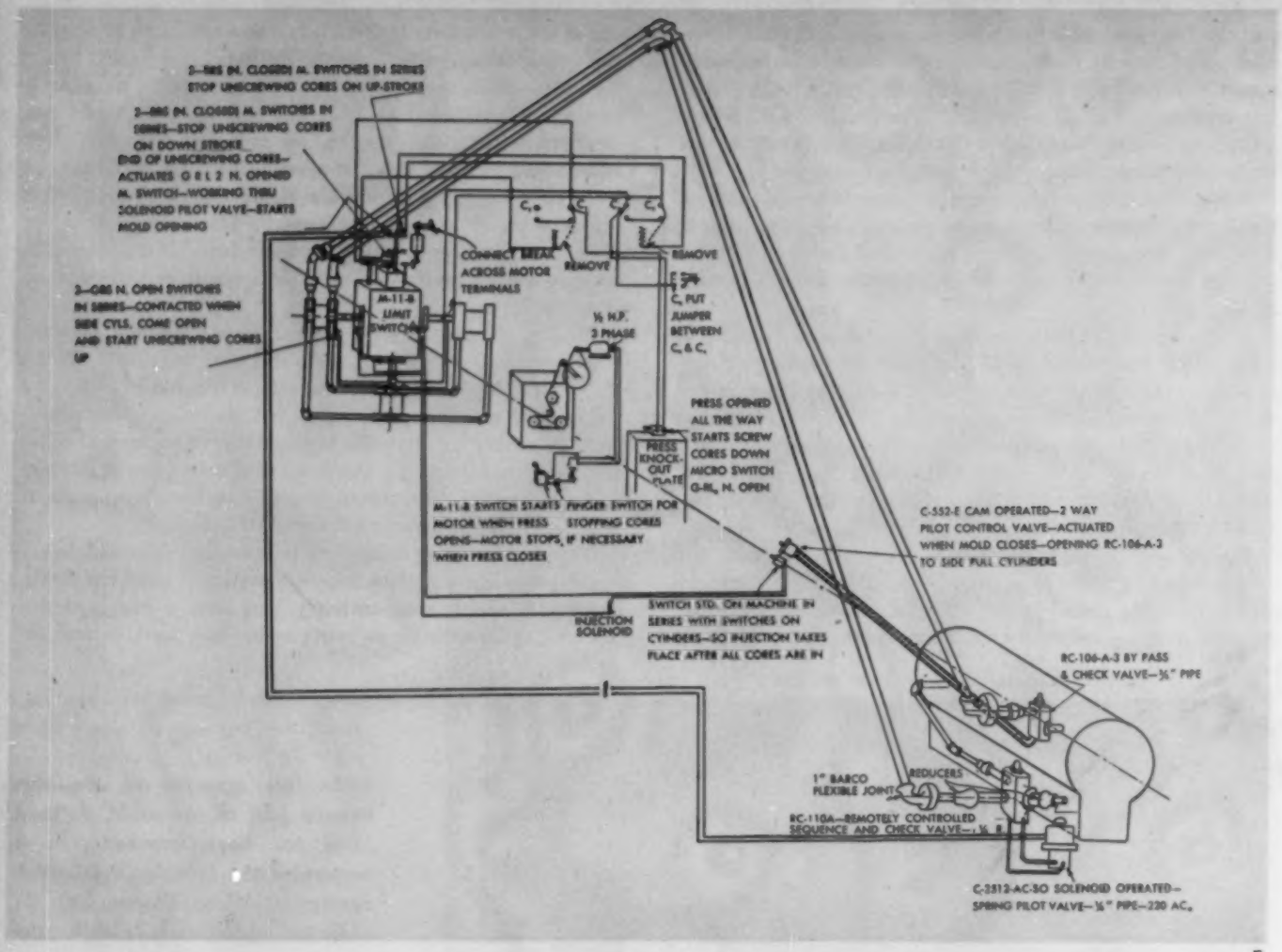
3

3—In this close-up of the stationary half of the mold, a cover plate has been removed from a section of the face (at the bottom center of this illustration) in order to show more clearly the mechanism that is used to withdraw pins from the mold



4

4—This is the movable half of the new mold for the thermoplastic M-52 trench mortar fuze. It is this section that contains the automatic unscrewing equipment for both the internal and external threads of these fuzes


2—GRS IN. CLOSED M. SWITCHES IN SERIES STOP UNSCREWING CORES ON UP-STROKE
2—GRS IN. CLOSED M. SWITCHES IN SERIES—STOP UNSCREWING CORES ON DOWN STROKE
END OF UNSCREWING CORES—ACTUATES G R L 2 N. OPENED M. SWITCH—WORKING THRU SOLENOID PILOT VALVE—STARTS MOLD OPENING
2—GRS N. OPEN SWITCHES IN SERIES—CONTACTED WHEN SIDE CYLS. COME OPEN AND START UNSCREWING CORES UP
M-11-B LIMIT SWITCH
CONNECT BREAK ACROSS MOTOR TERMINALS
REMOVE
REMOVE C, PUT JUMPER BETWEEN C, & C,
½ H.P. 3 PHASE
PRESS KNOCK-OUT PLATE
PRESS OPENED ALL THE WAY STARTS SCREW CORES DOWN MICRO SWITCH G-RL, N. OPEN
M-11-B SWITCH STARTS FINGER SWITCH FOR MOTOR WHEN PRESS STOPPING CORES OPENS—MOTOR STOPS, IF NECESSARY WHEN PRESS CLOSES
C-552-E CAM OPERATED—2 WAY PILOT CONTROL VALVE—ACTUATED WHEN MOLD CLOSES—OPENING RC-106-A-3 TO SIDE PULL CYLINDERS
INJECTION SOLENOID
SWITCH STD. ON MACHINE IN SERIES WITH SWITCHES ON CYLINDERS—SO INJECTION TAKES PLACE AFTER ALL CORES ARE IN
RC-106-A-3 BY PASS & CHECK VALVE—¾" PIPE
1" BARCO FLEXIBLE JOINT
REDUCERS
RC-110A—REMOTELY CONTROLLED SEQUENCE AND CHECK VALVE—1¼ P
C-2512-AC-SO SOLENOID OPERATED—SPRING PILOT VALVE—¼" PIPE—220 AC.

5

ward toward the center line of the mold all cores that had a horizontal inward motion. Two horizontal cylinders were used to supply motion to cores that were to be pulled to left and right. These also supplied motion to the seventh hole (30° to the vertical core) through the action of a rack and pinion which changed the direction of motion from horizontal to angular.

Pulling the threaded vertical core was not a simple problem in view of the fact that the core, about $1^1/_2$ in. long, is threaded at the top for about $^5/_{16}$ inch. It was necessary that the entire length be clear of the casting before the casting could be removed from the cavity. This meant either turning out the first $^5/_{16}$ in. with a rotary motion and pulling the balance with linear motion, or unscrewing the entire $1^1/_2$ in. of length. In the latter case something over 35 turns would be required before the core was completely out of the casting. Either method would be complicated since the portion of the mold above two of these cavities already had mechanisms directly in line with the motion of these cores, only working at right angles to them.

It was decided to pull the cores by turning them the entire length of their stroke. This was accomplished by extending the core into a nut having the same pitch as the threaded portion of the core and then threading the extended portion of the core so that if the core was given rotary motion it would turn itself up inside the stationary nut and thus pull the core from the casting. The rotary motion was delivered to the core by means of shafts, and spline shafts and gears working from a gearhead motor supported above the stationary plate of the mold.

After this mechanism was laid out so that it would operate geometrically, the next problem was that of controlling the motion. Since the critical dimension was the depth of the hole molded by the threaded core, it was necessary that the core rotate into the cavity to a certain depth and then stop at a critical point. To accomplish this, the stopping and starting of the motor had to be delicately controlled, a result obtained through the use of micro switches. When the core reached the position at which it was to stop, a micro switch was contacted which automatically stopped the motor. To make certain the motor did not continue to turn after the current was cut off, a solenoid brake was attached to the shaft through the motor—the brake controlled by the same micro switch that stopped the motor. Moreover, several micro switches were used in series to make sure of positive operation in case any one of them failed. This arrangement was necessary because it was imperative that the motor activating the equipment shut off properly or the mold would be seriously damaged.

Further confusing the problem was the fact that during the molding operation four cores bear against the vertical core. Consequently, it is necessary to pull all four cores away to prevent scoring of the threaded vertical core when it is pulled out. This was done in the case of three of these cores by direct motion of the hydraulic cylinders or indirectly by a cam action from the motion of these cylinders. As the fourth core was anchored in the movable section of the mold, and since there is no motion of the movable side of the mold until all the radial cores have been moved, the fourth core had to be moved through some action on the stationary part

of the mold. This action was taken from the motion of the vertical hydraulic cylinder which was converted through a cam to a rotary motion. This, in turn, was carried from the stationary to the movable half of the mold through a socket arrangement. This arrangement meshed at the parting line of the mold.

The movable section of the mold consists of cores which form four small-diameter holes in the bottom of the conical section and two large concentric threads on the cylindrical part of the casting. The cores form four holes assembled on one stationary plug about which rotates a thin sleeve core containing threads which form the female thread section of the casting. The male threads are formed by another sleeve rotating concentrically with the first sleeve. The source of motion for turning the sleeves is a small gearhead motor working through a chain and sprocket arrangement connected directly to the outer threaded core. Rotary motion is transmitted to the inner threaded core through splines in the outer threaded core. The outer core has no linear horizontal motion, but the inner core must have such a linear horizontal motion because of the difference in the pitch of the threads.

Opening the mold

When the mold is ready to open, but before the press actually opens, three hydraulic cylinders pull all radial cores and also, by indirect action, pull the axial cores which are bearing against the vertical threaded core. This clears the way for unscrewing the vertical threaded core. The start of this action is controlled through a series of switches connected so that the rotary action does not start until all three hydraulic cylinders have completed their outward motion. Then, the vertical cores unscrew a predetermined linear distance at which time another switch is contacted. This switch turns off the motor and automatically operates the solenoid brake to preclude any further rotation. The last-named switch opens the 4-way valve in the molding press which starts the mold opening. As the mold opens, another switch starts a motor controlling the threaded cores. As these cores turn, the castings are ejected from the mold. In closing the mold, the same type of controlled action is employed.

Conclusion

Entirely automatic, intricate but compact, this new mold for the M-52 fuze represents a definite departure from the conventional in the field of injection molding of thermoplastics. Although little time was allowed for the usual design alterations and refinements once the decision was made to proceed with the development, this new method has already demonstrated its ability to produce, in quantity, complicated shapes having close tolerances and to mold these products so they pass rigid inspection and difficult tests.

The computed capacity of 30,000 fuzes per month which has been made possible by the development of this new method is even more remarkable when it is remembered that work was started on the molds within 48 hr. after small sketches had demonstrated the feasibility of the project. Step by step the various problems were worked out until a mold was developed which would produce three M-52 trench mortar fuzes simultaneously. In view of the complicated construction of these fuzes, the compactness of the mold is noteworthy. The 200 and more moving parts are all contained in a body that has a face only 13 by 15 in. and a depth of 12 inches.

It is well to note that the thermoplastic mortar fuze is still in the experimental stages. Rated as one of the most complicated high-production war jobs yet tackled by the plastics industry and the one which has, without doubt, given the thermosetting molders more trouble than any job they ever tackled, it is little wonder that difficulties are still being encountered. However, with the close cooperation of the materials supplier and of the molder, high hopes are held for the eventual satisfactory full-scale production of this thermoplastic mortar fuze.

Credits—Material: Special ethyl cellulose material developed by Hercules Powder Co., Inc. Mold developed by the Elmer E. MillsCorp.

ALL DRAWINGS, COURTESY ELMER E. MILLS CORP.

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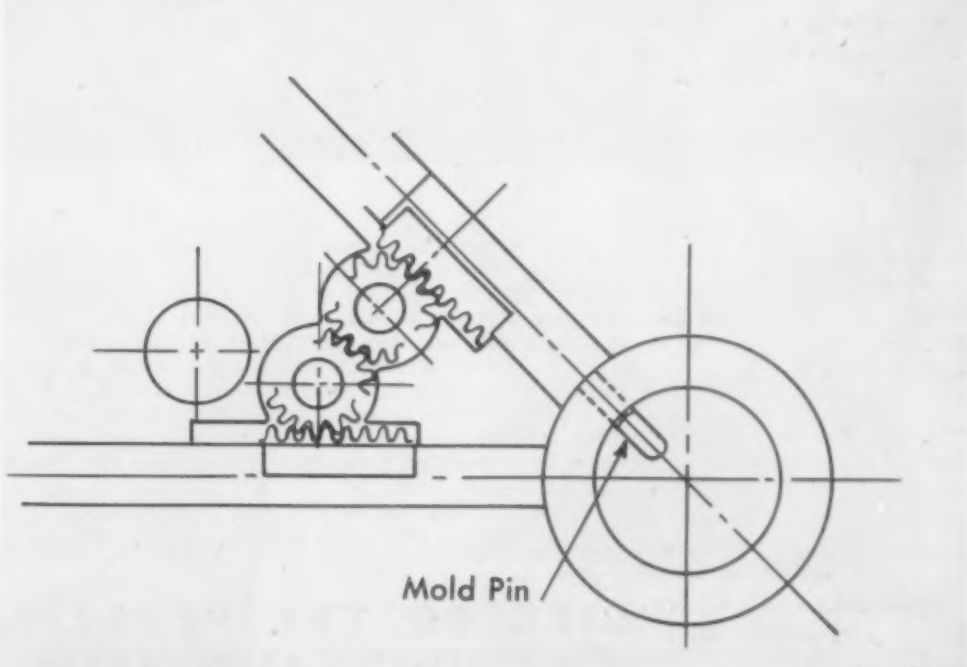

5—The most important details of the control system of the fully automatic 3-cavity mold for the M-52 fuze are given on this drawing. 6—A rack and gear system such as this is used to withdraw the side pins from the mold

Melmac Plastic ...a New Farm Hand

Jobs on the farm can't wait! Farm machinery must operate smoothly and efficiently, day after day, in spite of constant use, and the abuse of exposure to weather and extreme service conditions. Ignition systems in tractors and binders, reapers and combines, water pumps and power plants, must function properly regardless of heat, cold, and humidity, in spite of dust and dirt which cause damaging flashovers and shorts.

Mineral-filled MELMAC*, the new insulating plastic developed by Cyanamid for distributors, magnetos, and many other dielectric parts, helps to insure quick-starting, smooth-acting, dependable power in stationary and portable engines. Its high heat resistance, non-inflammability, and resistance to arc-tracking under the most severe service conditions, mean uninterrupted performance, lengthen the life, and improve the serviceability of electrical equipment.

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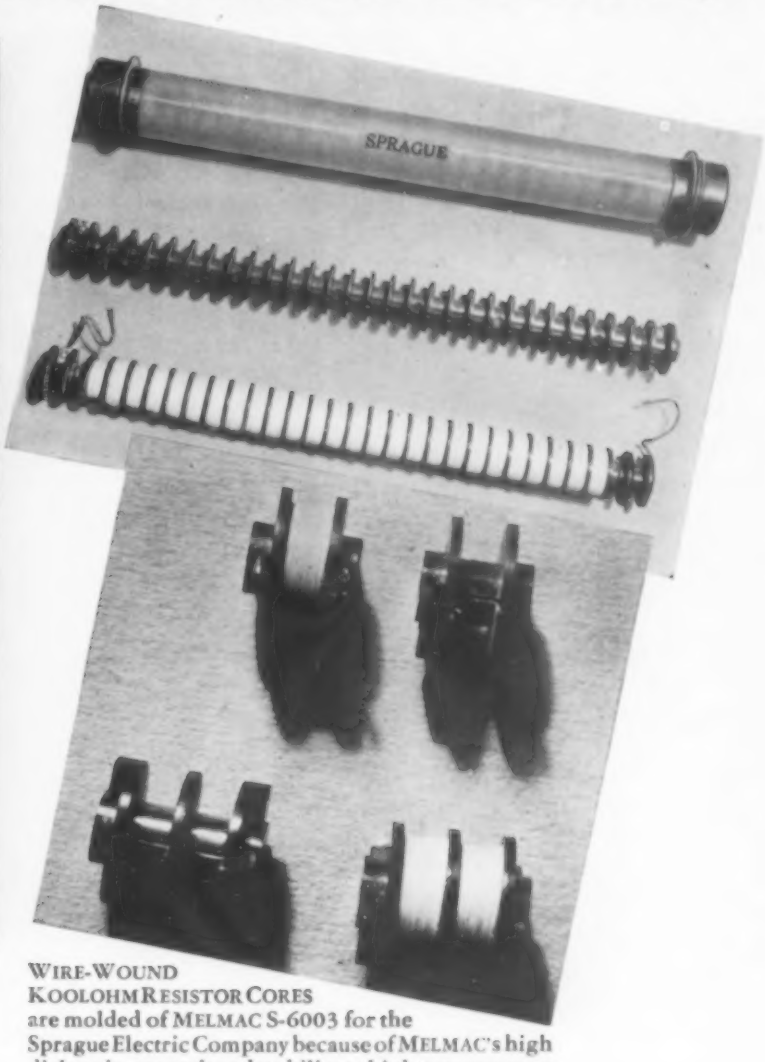

WIRE-WOUND
KOOLOHM RESISTOR CORES
are molded of MELMAC S-6003 for the Sprague Electric Company because of MELMAC's high dielectric strength and stability at high temperatures.

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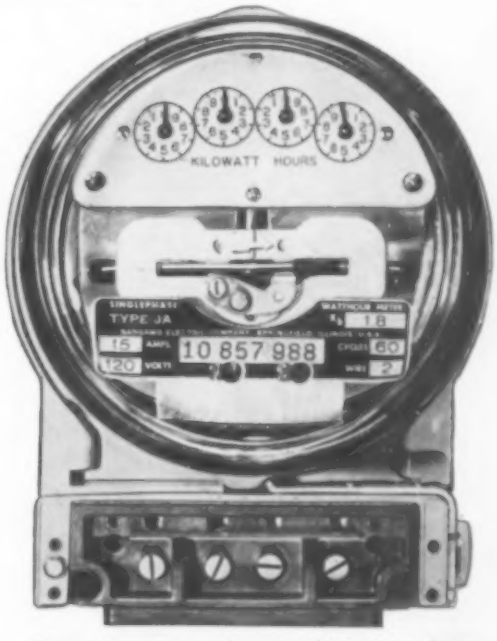


MELMAC's arc resistance (A.S.T.M. Avge. 130 sec.) dielectric strength (430 Volts/Mil.), and heat resistance (300°F.) determined its choice for the Sangamo Electric Company watt-hour meter terminal blocks.

Maintenance of injection machines

THE injection machines in virtually every molding plant in the United States have become increasingly powerful factors in our war effort. Detection devices and rockets rely on the injection machine for vital components, as do many less spectacular application ssuch as toothbrushes and soap boxes. Ammunition rollers, practice automatics, sun glasses, bayonet and machete handles, ear plugs and boxes, emergency ration containers and numerous personal items used by our fighting men are injection molded. And the range of plastic products which these machines can turn out is being widened daily. New heat-stable thermoplastics, and the injection of thermosets are placing new demands upon our injection machines. The fact that WPB restrictions on the manufacture of new injection machinery are so severe, coupled with the fact that most molders are now operating twenty-four hours a day, make it vitally important that our injection machinery—regardless of make or age—stays on the job. With proper care it can and will.

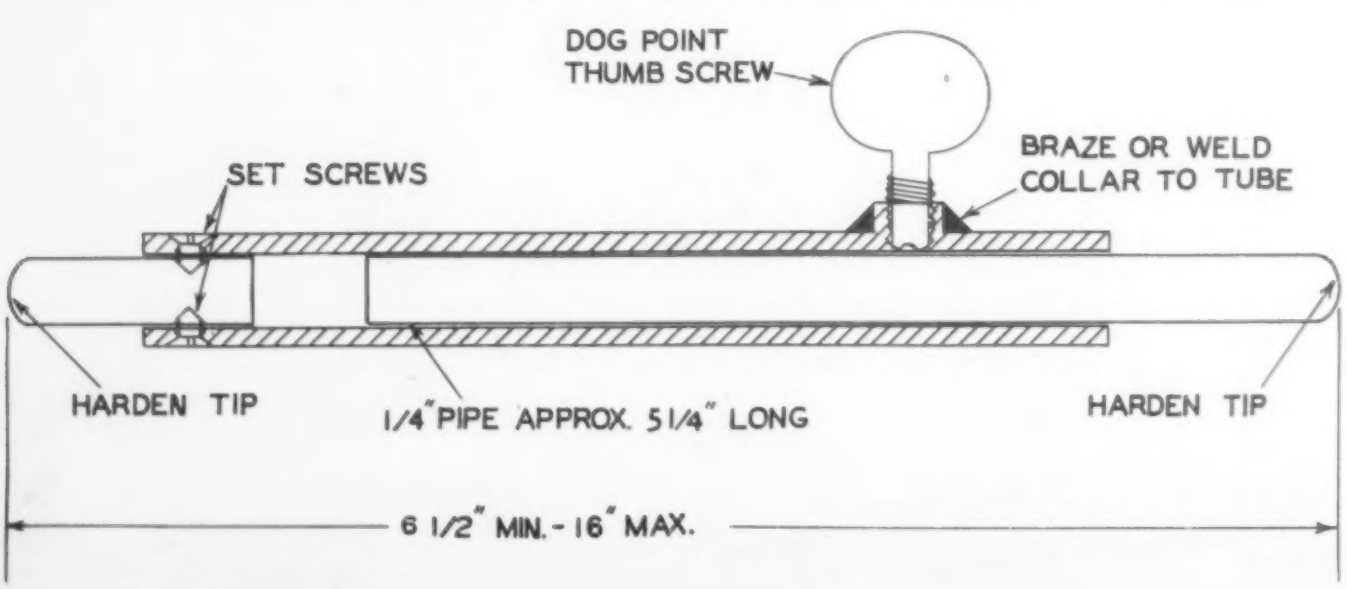
The rules are simple. Know your machinery. This is easily said, but with manpower shortage, the draft and labor turnover, it is not always possible to carry out all the recommendations of the equipment manufacturers. While some of these recommendations are highly theoretical, many are sound and, if followed, can save much avoidable down-time. A great many machine breakdowns can, to a large extent, be forestalled by proper design of dies. Injection machines should not be overloaded, capacity should be held within the limits given by the machine manufacturer. The die locking mechanism should not be overloaded in an attempt to use a casting area too great for it to hold.

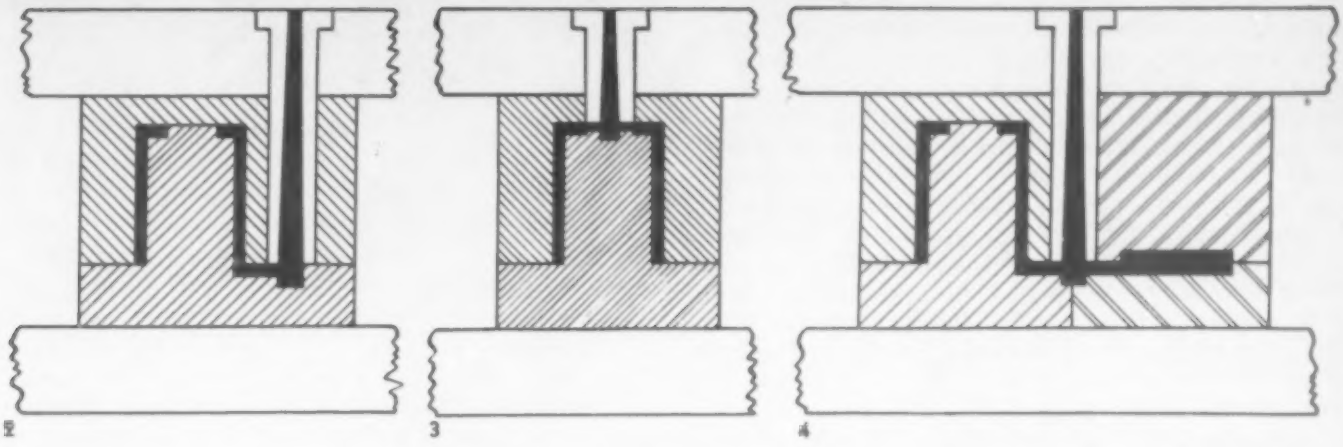
Under present war conditions, however, it is sometimes absolutely necessary to overload equipment. In this case several precautions should be observed. First, make sure that the die plates are absolutely free of grease, dirt and lint before the dies are installed. In tie-bar type machines which are adjustable for die thickness, use an inside mike between the platen faces as a double check to assure that the machine is set up squarely so as to avoid an uneven strain in the link mechanism. A homemade "mike" (Fig. 1), consisting of a piece of pipe with a hardened steel plug in one end and an adjustable plug with thumbscrew, is sometimes used for checking on the setup.

In building single-impression dies—especially those with large molding areas—where the cavity must be placed off center, a simple disk-like cavity is sometimes inserted opposite the actual molding to bring the strain on the clamping mechanism into balance and prevent an uneven strain on the injection machine. On certain machines of the tie-bar type it is sometimes possible to compensate for off-balance dies by an uneven adjustment of the tie-bar nuts. This is a widespread but not recommended practice. It leads to premature wear in link-type machines, or uncontrollable flash or variable piece dimensions in other types of equipment. Whatever the case, a mold should never be constructed so as to occupy only one half of the platen area to one side of the sprue. Such an arrangement will cause uneven wear on any type of injection machine, regardless of make.

It is possible to injure any make of injection machine by attempting to lock it too tightly by raising the pump pressure beyond prescribed limits. It is also possible to set up link-type machines so that far greater clamping pressure is exerted than is actually necessary for good molding at a fast cycle. Damage to the molds as well as the machine has resulted from straining the clamping mechanism. It is well to examine factors such as material (heater) temperature and injection pressure before jumping to the conclusion that the clamp mechanism should be tightened or clamping pressure raised. It is often possible to mold at a lower pressure than was originally tried. At mold setup especially, the material in the heater is sometimes overheated. Flashing of trial shots leads the setup man to overtighten the clamping mechanism instead of waiting for the heater to even out. Very seldom will he

1—This homemade "mike," consisting of a piece of pipe with a hardened steel plug in one end and an adjustable plug with thumb screw, is used to check the setup of die plates on injection machines with independent tie-bar adjustments





2—How not to set up a single-cavity side-gated mold. Here the molded area is off center, placing undue strain on clamping mechanism and causing "flashing." 3—Optimum way to design and gate single-cavity mold. Although molded area in the center of the bottom of cup is not used, it can be designed as a disk gate. 4—This mold layout is also satisfactory but more costly than that in Fig. 3. It should be used if side gating is necessary. 5—This part illustrates various theories on proper design and setup of mold to eliminate undue strain on clamping mechanism

adjust the machine to a lesser clamping pressure. Consequently, the equipment goes into production straining and imposing unnecessary wear and tear on pins, bushings, tie-bar bushings and other movable parts. Particularly in the injection of thermosets, the expansion of the mold must be taken into consideration and final adjustments for setup made only when molds and platens are up to full working temperature.

Many molders persist in designing molds with very small runners and with gates that are sometimes only a few thousandths in thickness. Some mold makers deliver molds without any gates at all, leaving it to the molder to cut his own. Gates are made small to avoid trimming and finishing costs, but little thought has been given to the fact that this practice imposes a greatly increased strain on the injection machine, particularly on the heater. Therefore, a slight increase in finishing cost due to insistence upon larger gates should be weighed against additional maintenance costs on the injection machine and the resulting costly down-time that will result if small gates are used.

Plastics engineers have seen case after case where larger sprues, gates and runners have cut down required injection pressure, given a more dimensionally stable molded piece as a result of a decrease in internal welds as the cavity filled, and in the long run almost eliminated a variety of heater troubles. The cycle is seldom affected by such a change. As the gates and other mold passages are enlarged, the material can be injected at a lower temperature. Consequently, "setting" or hardening time remains about the same. A lower injection temperature and pressure means that the heater is subjected to fewer strains, and there is less likelihood of the material reaching the point where decomposition sets in with an attendant release of chemicals which are sometimes corrosive.

The heater is the heart of every injection machine and, probably, causes a molder the most "grief." It is difficult to do a plating job that is 100 percent satisfactory on the internal portions of a heater. Furthermore, due to the problems of differential expansion, plating life inside a heater is known to be short. To prevent corrosion which, in the past year, has become a real menace to the record of injection-machine production, one prominent manufacturer uses stainless steel for all heater segments that come in contact with the hot plastic. Hastelloy-lined heaters have proved resistant to every known plastic even under the most severe and abusive conditions. However, their cost is nearly three times that of the standard heater and, for that reason, comparatively few are in use today.

We hesitate to mention the variety of objects that have recently been found obstructing the nozzles of various injection machines—objects for example that have fallen from a shirt pocket into the material as it was being scooped from a barrel. Coins, screws and metal shavings have been found in the machines. In one case, heater trouble was traced to pieces of a brass rod used to poke the sprues and runners into the feed cylinder, which had been nipped off by the plunger.

It has been found advisable when shutting down injection machines, possibly because of certain unpreventable changes in the molding compounds during recent months, to pump out a few shots. This prevents overheating and helps cool the

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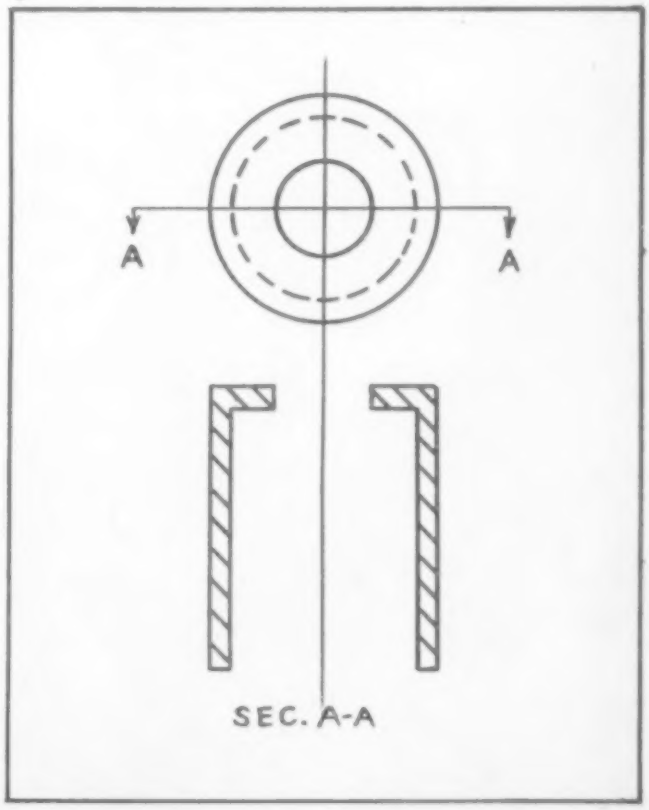

heater to the point where violent fuming of the plastic ceases when it is shot from the nozzle into the air. Burnt material, which is hard and abrasive, is very difficult to dislodge from the inside of a heater, and it is recommended that every precaution be taken to prevent overheating of all, or nearly all, present-day (wartime) plastics. A periodic check of instruments, pyrometers, controllers and thermocouples should be a part of every maintenance program. Loose instrument mountings, poor electrical connections, open wiring—all contribute their share to preventable down-time. It is important to dry all materials before molding, since any moisture that may be present can combine chemically with certain elements of the material to produce corrosive acids which attack joints in the heater or nozzle threads.

An amazingly efficient method of preserving nozzle threads as well as bolts used in assembly of heaters is to coat them with the new silicone stop cock grease. It is also well to coat the tip of the nozzle and front end of the heater with it, as it will prevent the hot plastic from sticking. This is a recent and important development and should be noted by maintenance men as well as injection machine manufacturers.

Maintenance of hydraulic systems is an often neglected item on the down-time list. The more progressive molders have now installed integral or portable oil filters, which not only remove the moisture that is present in the oil as a result of condensation or sweating of tank lids or roofs, but also tend to correct acidity. These filters have materially reduced if not eliminated gumming of valves, rusting of valves over shutdowns, excessive pump wear and countless other minor erratic troubles of the hydraulic system. When hydraulic oil is left untended until the strainer, which prevents particles of plastic, scale, lint or other contaminants from getting into the pump, is dirty, the machine has already suffered internal damage from the constant action of the small abrasive particles that *did* get through the screen. Furthermore, it is impossible to achieve the desired pressures on a neglected machine since countless internal leakages tend to take more oil than the pump can deliver. Some concerns have experimented with cheaper oils or with types of oil not recommended by equipment manufacturers. There is no need to comment on the ultimate cost of this false economy either to the war program or to the molder.

Automatic lubrication of all moving parts is now provided on all the models of link-type machines offered by one large manufacturer. But the need remains for a a rigid routine to observe that the oil reservoir is filled regularly and that all oil lines are intact. Failure to lubricate pump and motor bearings (pumps and motors are often concealed under housings) and to provide lubrication for flexible couplings between motors and pumps have also contributed to our invisible sabotage.

Too often only cursory attention is given to the levelling of the machine as it is installed. Correct levelling, however, is very important to machine life, for a machine on an irregular floor or unevenly held down is subject to numerous strains and uneven wear.

Many features of machine maintenance are so obvious that it almost seems unnecessary to mention them. Cleanliness is an example. However, even under normal conditions when sufficient help is available, cleanliness seems hard to achieve. And now, under the most adverse conditions, it is doubly important. Contamination of expensive raw materials, safety and efficiency are but a few of the more obvious results of keeping a clean plant. Regular inspection of hydraulic, electric and mechanical safety gates is a simple matter that can save hours of time, possibly even the work of a man.

To do an all-out job for the war program, our injection machines must be kept running. If minimum maintenance needs for each machine, such as spare heaters, gaskets, coils, timers, controllert ubes and relays can be anticipated (the equipment manufacturers will gladly furnish suggested inventories of such items), hours and days of waiting for parts can be avoided. Times are not normal, and the best protection against shutdowns of injection machines is to follow the advice of the engineers of the machinery companies, even though it means a change here, discarding a prejudice there, or planning for current emergencies which at any other time would be considered merely routine matters that could be very quickly serviced. (*Please turn to page 196*)

PHOTOS, COURTESY HONAN-CRANE CORP.

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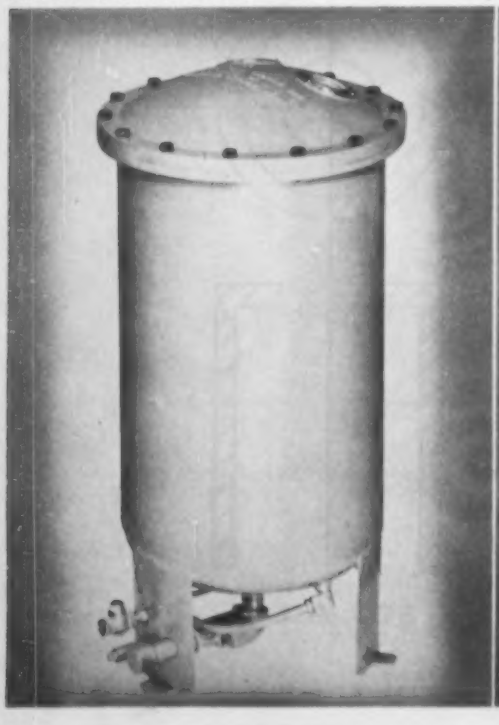

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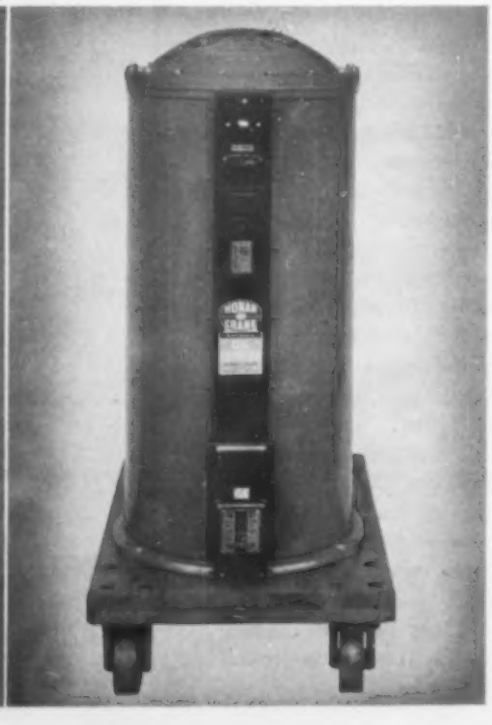
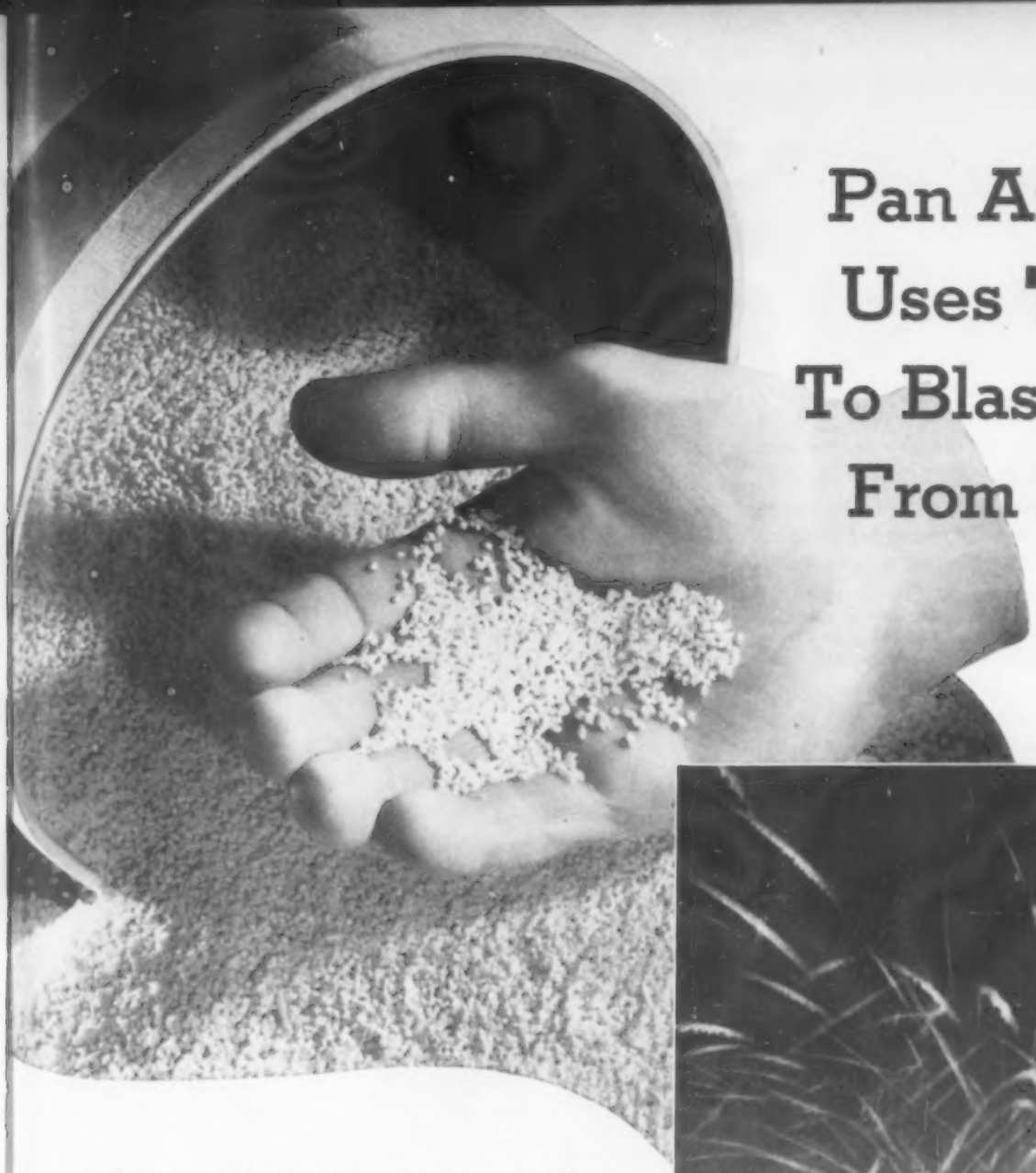


6—*This integral oil filter not only removes moisture present in oil as a result of condensation or sweating of tank lids or roofs, but also tends to correct acidity.* **7**—*If preferred, the oil filter can be obtained in a portable model for use on the injection machines*



Pan American Uses **Tenite** To Blast Carbon From Pistons

GRANULATIONS of Tenite are used by Pan American World Airways to blast carbon from pistons. Blown at high pressure in sand-blasting equipment, the pellets knock carbon from piston sides and ring grooves and give the metal a polish without abrasion.

By the addition of Tenite pellets to the clover seed, wheat, or cracked corn particles previously used alone, blasting time may be cut in half. The grain particles absorb the oily smudge from the pellets and, when reduced to a flour, pass out of the exhaust. Tenite, by virtue of its extreme toughness, does not become pulverized from the force of blasting; and only four to five ounces of Tenite pellets in a charge are consumed per blasting hour.

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(*Subsidiary of Eastman Kodak Company*)
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WHY TRANSFER MOLDING GIVES FINE INSERTS

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In this process, the thermosetting compound is subject to heat and pressure in a chamber connected with the mold cavity. The compound flows into the mold cavity, which has been previously closed with the inserts already in position. "Curing" takes place in the mold, which is then opened for removal of the parts.

The flow of the fully plasticized compound into the closed mold cavity avoids damaging or dislocating inserts, which can occur in compression molding, where the material is crushed against the inserts. Thus, transfer molding permits the production of parts which have delicate inserts, such as the two samples shown at right.

The body of the larger piece is about 2¾" long. The thermosetting plastic flowed evenly around the thin metal inserts without disturbing them in the least. In the small piece, which is about ¾" long, thin copper wire has been precisely placed and left undamaged.

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A list of licensed transfer molders near your own plant will be furnished upon request. Reprints of technical articles prepared by Shaw engineers are also available.

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Plax supplies Cellulose Acetate Butyrate in film, sheet, slab, rod, tubing, blown ware and fiber — in all colors, from clear to pearlescent. Characteristics are as follows:

MECHANICAL	
Tensile Strength, p.s.i.	2500-6700
Modulus of Elasticity in Tension, p.s.i.x10^3	0.6-2.0
Compressive Strength, p.s.i.	7500-22,000
Flexural Strength, p.s.i.	2000-13,000
Rockwell Hardness	M25-M69
Impact Strength, ft. lbs. per in. of notch; ½" x ⅛" notched bar Izod test	0.8-7.9
Water Absorption, 24 hrs., %	1.6-2.1
ELECTRICAL	
Volume Resistivity, ohm. cms. (50% rel. hum. at 25°C)	10^{10}-10^{12}
Dielectric Strength Short Time, Volts per mil, ⅛" thick	250-400
THERMAL	
Distortion Temperature, °F	115-215
Transition Temperature, °F	117-160
Softening Point, °F	140-250
Specific Heat, cal. per °C per gram	0.3-0.4
Burning Rate	Slow
Thermal Expansion, 10^{-5} per °C	11-16
Thermal Conductivity, 10^{-4} cal. per sec. per sq. cm/1°C per c.m.	4.5-7.8
Resistance to Heat (continuous) °F	140-220
CHEMICAL EFFECTS	
Weak Acids	Slight
Strong Acids	Decomposes
Weak Alkalis	Slight
Strong Alkalis	Decomposes
Alcohols	Softens
Esters	Dissolves
Ketones	Dissolves
Hydrocarbons	Little Effect

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TECHNICAL SECTION

DR. GORDON M. KLINE, Technical Editor

Relative temperature stability of stressed plastics

by J. A. SAUER, F. A. SCHWERTZ and D. L. WORF*

THE properties of plastic materials are so markedly affected by temperature changes of relatively small magnitude that practically no applications exist where the temperature behavior of the materials can be entirely ignored. A knowledge of the effect of temperature and of temperature changes on the physical properties of plastics is therefore a prerequisite for intelligent specification and use.

Considerable information pertaining to the behavior of plastics at various temperatures is presently available. Most of the pertinent facts have been admirably summarized by Carswell and Nason,[1] who show the effect of temperature on various properties of a number of different plastic materials. It is the purpose of this paper to add to this information some comparative data on the temperature stability of various plastics under stress.

The usual method for measuring the relative stability of plastics under stress is the so-called heat-distortion test. This procedure, with suitable modifications, is excellent for simply and quickly obtaining useful comparative data on the heat stability of the various plastics or of the various types and modifications of the same plastic. However, recorded heat-distortion temperatures show considerable divergence and lack of uniformity. The discrepancies arise, in large measure, from differences in technique employed in carrying out the measurements, from differences in the preconditioning given to the specimens, and from failure to record the specific modifications or flow types of the plastic being tested, which is especially serious because of the wide variation in properties obtained from a single base resin.

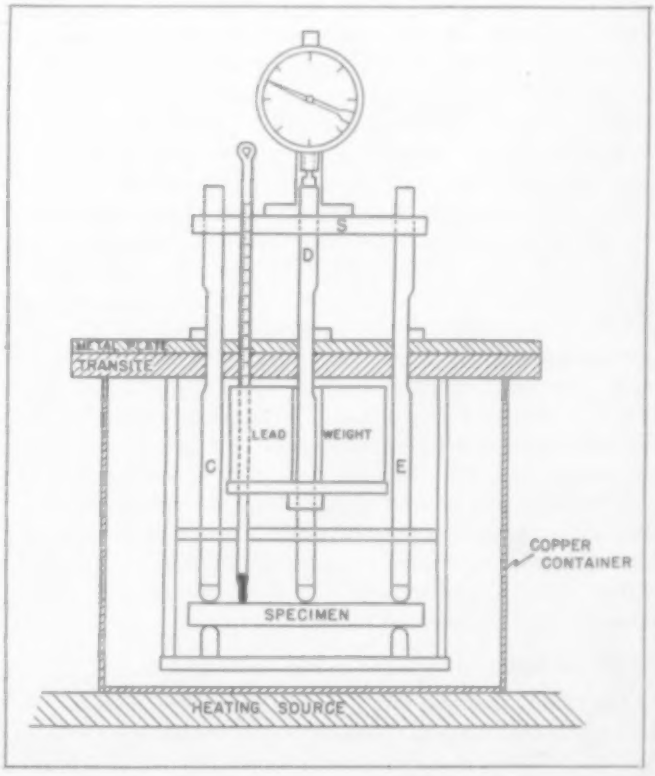
In the present study, every effort has been made to avoid or overcome the causes which give rise to these discrepancies. All the tests herein reported have been carried out under definite and reproducible conditions. Every specimen examined was conditioned at room temperature and 50 percent relative humidity for a minimum time of 48 hr., and a vast majority of the specimens for a minimum of 60 days. Whenever possible, samples of each of the important modifications of the same base plastic were secured, and all findings that are presented specifically include the modifications or trade names and types as well as the general chemical designations of the test samples.

Apparatus and test procedure

The apparatus used for carrying out the heat-distortion test is shown in Fig. 1. Although basically similar to the device described by the A.S.T.M.,[2] it has been suitably modified to take account of the effect of specimen expansion. This modification is necessary if the true relative temperature stability of the various plastics is desired. In the standard apparatus, the initial expansion of the specimen produces a negative reading on the dial gage (which is rigidly attached to the cover plate). The so-called heat-distortion point of the plastic material—arbitrarily defined as the temperature at which the deflection of the mid-point of a $^1/_2$ by $^1/_2$ by 5-in. bar, simply supported at both ends, and acted upon by a central load of 2.5 kg., reaches 10 mils—is then the temperature at which the *dial reading* is 10 mils. As the temperature increases, the dial tends to move in a direction opposite to that

[2] A.S.T.M. Standards on Plastics, p. 178 (Oct. 1943).

1—Apparatus for heat-distortion test. Dial indicator is supported by platform (S), which in turn is supported by rods (C and E). Rod (D), of the same material as C and E, goes through a hole in S and contacts dial pin



* Mellon Institute of Industrial Research.

[1] T. S. Carswell and H. K. Nason, MODERN PLASTICS *21*, 121 (June 1944).

produced by expansion. Therefore, the heat-distortion point of the plastic measured with the standard apparatus is actually the temperature at which the distortion or deflection reaches a certain sum corresponding to the total of 10 mils plus the amount of differential expansion between the specimen and the metal specimen support.

The average amount of this expansion is of the order of 3 mils. Since the initial selection of the heat-distortion point as the temperature at which the specimen deflection reaches 10 mils is purely arbitrary, it might seem, at first glance, that no harm would be done if this value were changed to 13 mils. However, the coefficient of thermal expansion of different plastics varies all the way from 2×10^{-5} to 25×10^{-5} per °C. This fact means that for one material the heat-distortion temperature may correspond to a deflection of approximately 11 mils, for another 13 mils, and for a third perhaps 15 mils.

The manner in which the A.S.T.M. apparatus was modified to correct for expansion will be clear from Fig. 1. The dial indicator is supported by the platform *S*. The platform, in turn, is supported by the rods *C* and *E*. The rod *D*, which is made of the same material as *C* and *E*, goes through a hole in *S* and contacts the dial pin. Any change in the thickness of the test bar because of expansion raises each of the three rods by the same amount, and the dial indicator is unaffected.

The test procedure consisted of placing the entire apparatus containing the loaded specimen in an oil bath and raising the temperature of the latter at a constant rate of approximately 2° C. per minute. Various media for heating the apparatus have been tried. Water was considered unsatisfactory as the heating medium because the temperature is limited to the boiling point and also because many organic plastics are affected chemically or physically by hot water. Air was regarded as satisfactory from the standpoint of convenience and cleanliness, but its inherently poor heat transfer rate excluded it as a practical heating medium. A suitably agitated petroleum oil, such as SAE 30, was finally selected as being the most suitable because most organic plastics are unaffected either physically or chemically by its presence and also because it gives a quick and convenient heat transfer. The rapid heat transfer is attested by the fact that, within the limits of accuracy of the apparatus, no change was found to occur in the heat distortion temperature of polymethyl methacrylate specimens where the specimens were varied in width from $\frac{1}{2}$ to $\frac{1}{8}$ in., provided, of course, the load was likewise varied so as to keep the fiber stress constant at all times.

All the specimens tested were preconditioned, unless specifically stated otherwise, for at least 60 days at room temperature and 50 percent relative humidity. Thus it was made certain that all were in full equilibrium with prevailing atmospheric conditions and the latter were alike for all materials.

Whenever possible the tests were continued and the deflection readings taken at varying intervals of temperature until a temperature was reached at which the rate of deflection reached 10 mils per minute. This temperature is called the rate distortion temperature and it, together with the cumulative distortion temperature, gives a more complete picture of the heat stability properties of the various plastics than either temperature alone. The highest temperatures attainable with our apparatus were about 200° C., and the highest values at which the 2° C. per min. heating rate could be maintained were around 150° C.

Results of tests

The cumulative and rate heat-distortion temperatures for both thermoplastic and thermosetting materials are given in Table I. Where rate distortion temperatures are not listed,

TABLE I.—HEAT-DISTORTION TEMPERATURES OF VARIOUS THERMOPLASTIC AND THERMOSETTING MATERIALS

Basic chemical type	*Trade name*	*Mfr.'s No.*	*Heat-distortion temperatures*	
			Cumulative	*Rate*
			° *C.*	° *C.*
Ethyl cellulose	Ethocel	ER204MS	50.5	54.3
	Ethocel	2760	52.5	72.8
	Hercules EC	EC # 2	52.5	68.8
Cellulose acetate	Tenite I	008A57	51.1	54.5
	Tenite I	006AS	64.0	76.5
	Tenite I	006AH$_4$	79.3	100.0
	Fibestos	D-10	51.8	54.3
	Lumarith	11800	53.9	59.0
	Lumarith	12639	57.3	77.5
	Nixonite	342-77	51.9	56.3
	Nixonite	633	68.4	72.1
Cellulose acetate butyrate	Tenite II	202A	52.8	57.5
	Tenite II	201 AH	65.0	88.3
	Tenite II	201 AH$_5$	77.8	107.4
Cellulose nitrate	Herculoid	439-88-2	51.2	54.3
	Herculoid	41XC	55.8	61.8
Vinylidene chloride	Saran	M-1773-62	61.3	124.5
Vinyl chloride acetate	Vinylite	W-2651	63.0	64.8
	Vinylite	W-2653	67.0	68.8
Methyl methacrylate	Crystalite	Y-100	78.9	88.2
	Plexiglas		76.3	81.0
	Lucite		75.7	81.0
Polystyrene	Styron	K-88	81.0	86.0
	Styron	K-27	83.4	86.8
	Lustron	D-8	88.0	90.5
Polyamide	Nylon[a]	FM-1	80.5	....
	Nylon[a]	FM-1	61.5[b]	....
Copolymer of styrene	Cerex		128.0[b]	132.0[b]
Allyl resin	Allymer resin		72.3	....
Casein	Purple ameroid	4539	78.4	101.5
Phenol - formaldehyde	Opalon	D-5	79.0	82.0
	Micarta (post-forming)	#33759	103.0	....
	Resinox	D-6	121.8	162.5
	Resinox	D-7	159.0	....
	Micarta	Asbestos III	154.3	....
		Kraft paper I	193.0	....
		Fine cotton II	193.5	....
		Fiberglas IV	200°	....
	Textolite	1854	127.8	....
		1880	193.3	....
Aniline - formaldehyde	Cibanite	Ciba E	112.8	119.1
Urea - formaldehyde			120.5[b]	....
Lignin	Lignolite	LB10	123.1	....
Melamine - formaldehyde	Melmac	P-6003	131.0	....
		P-592	135.0	....
Bagasse lignin	Valite	8003L	151.0	....

[a] Nylon samples taken from different batches.
[b] These samples preconditioned only 48 hr. at 50 percent relative humidity and room temperature.

the true value was not attainable on the existing apparatus but is definitely above 150° C. The heat-distortion values in Table I are average values taken from the results obtained on at least two specimens. The individual values differed in only a few instances by more than 2° C.

Figure 2 shows the behavior of a typical thermoplastic material as the temperature is increased. The circles on the curves represent the points corresponding to the cumulative and rate distortion temperatures.

Figures 3, 4, 5 and 6 show comparative temperature-deflection curves of various types of plastic materials. The materials represented in Fig. 3 include 2 typical thermosetting and 2 typical thermoplastic materials as well as 3 others which are not easily classified. Figure 4 contains curves for cellulosic compounds and laminates. Figure 5 includes curves for vinyl and styrene compounds. Figure 6 contains temperature-deflection curves for some typical thermosetting materials. (*Please turn to next page*)

2—*These curves show the behavior of a typical thermoplastic material under the effect of increasing temperatures.* **3**—*The materials represented on this graph include two typical thermosets and two typical thermoplastics as well as three other materials which are not easily classified.* **4**—*Temperature-deflection curves for cellulosic compounds and laminates.* **5**—*Included in this chart are curves of deflection for vinyl and styrene compounds.* **6**—*Deflective action of increasing temperature on some typical thermosetting materials. Deflection in each case is indicated in mils*

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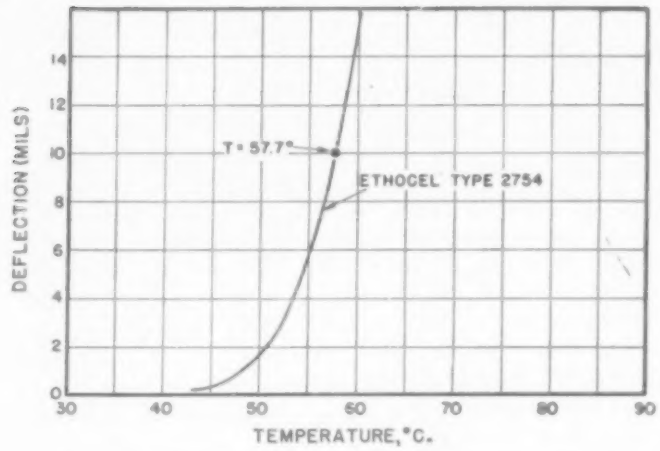

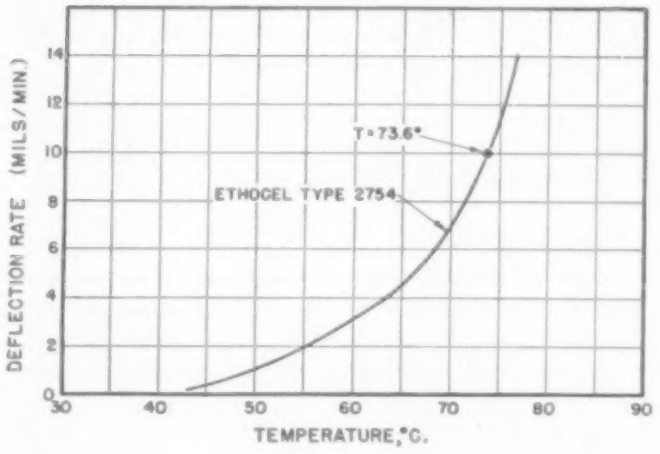

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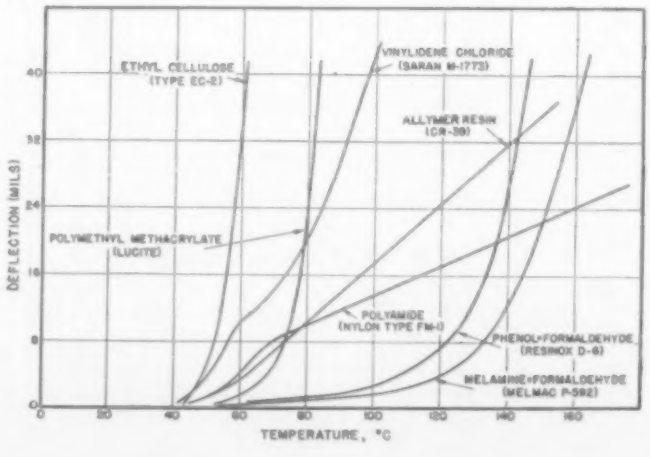

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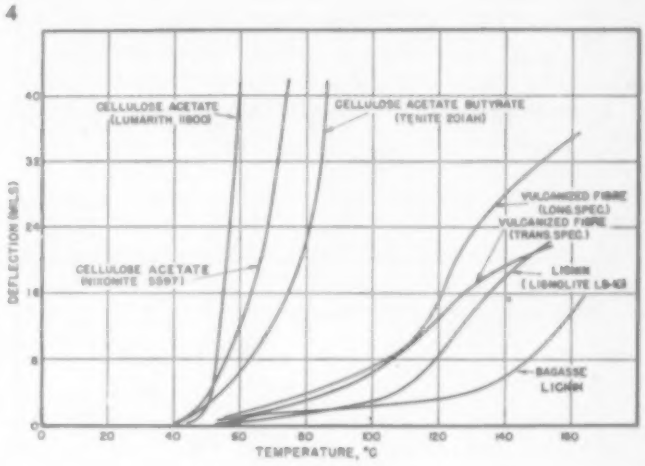

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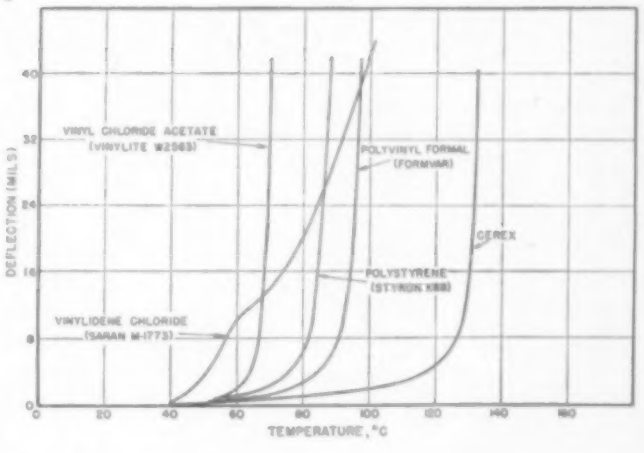

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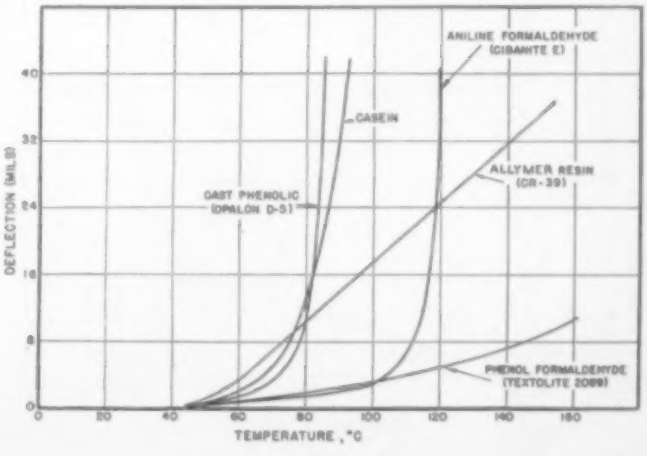

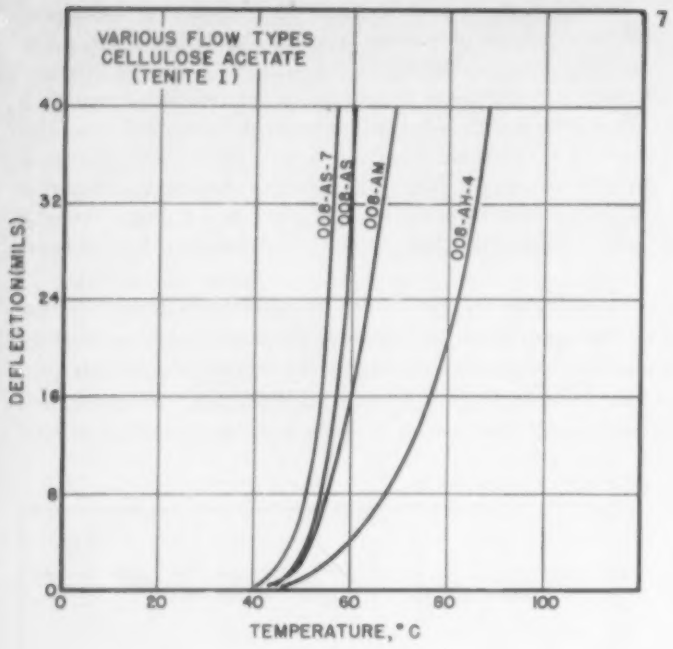

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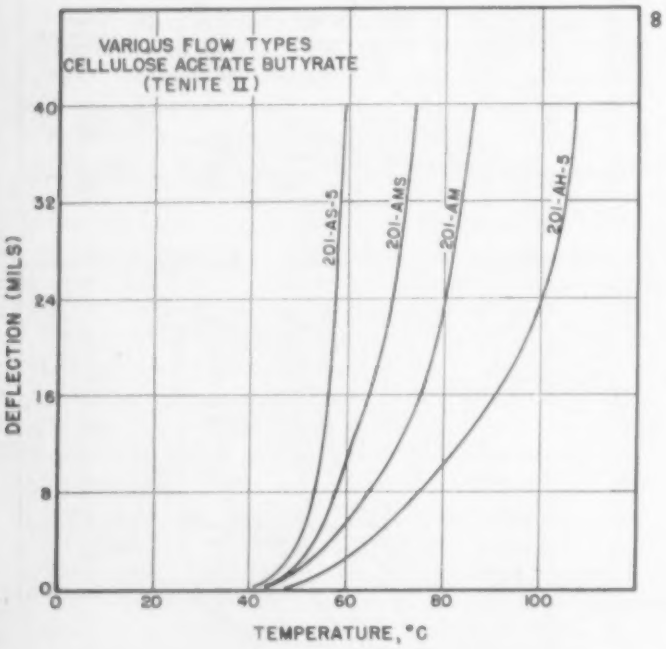

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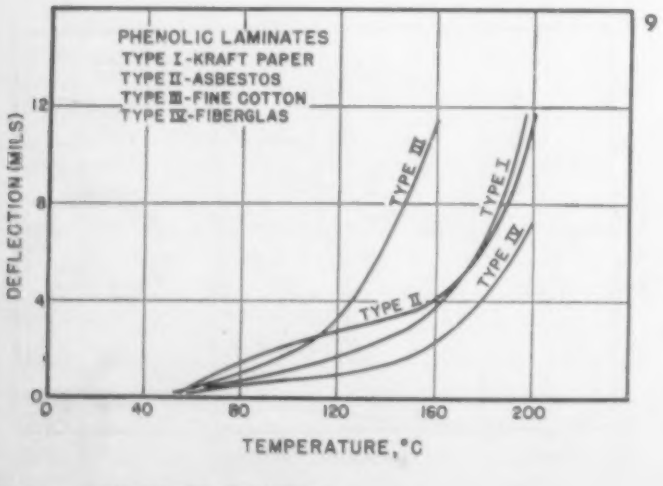

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Figures 7, 8 and 9 show the changes occurring in the temperature deflection curves owing to modifications of the basic material by changes of plasticizer, filler or other alterations.

In order to illustrate the change in heat distortion values caused by neglecting the effect of specimen expansion, one series of tests was run in the prescribed A.S.T.M fashion, i.e., with the dial gage supported on the cover of the container instead of on the specimen itself. The results of this series of tests is given in Table II, and some comparative temperature-deflection curves are shown in Fig. 10.

A third series of tests was run on various plastic materials in which the load on the specimen was reduced from P (2.5 kg.) to P/2 and P/4. The results are given in Table III.

Comparative temperature-deflection and temperature-deflection rate curves for the different loadings are set forth in Fig. 11.

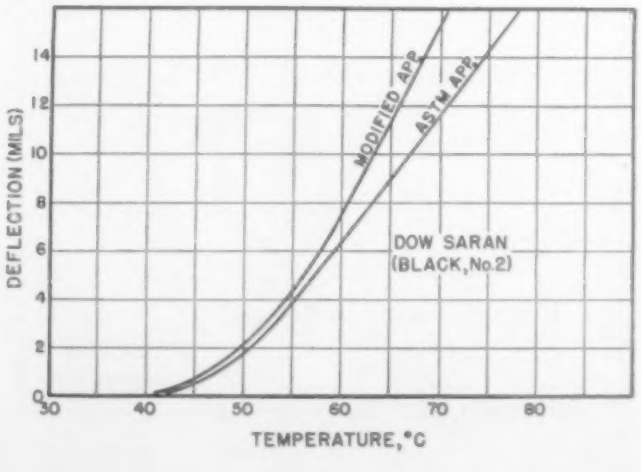
Discussion of results

It is interesting to note that the temperature versus deflection curves have essentially the same shape for both thermosetting and thermoplastic materials. At low temperatures, the rate of change of deflection with temperature is small, while at temperatures in the neighborhood of the heat-distortion point the rate of change increases rapidly (see Fig. 2). The difference between most thermosetting and thermoplastic materials is thus one of degree only, the distortion point usually being higher in the case of the thermosetting materials. This fact indicates that nearly all thermosetting materials can be "post-formed" and that the only reason some are considered superior to others is that the forming can be done at lower temperatures.

It will be noted that a few materials behave in a manner other than described above. These are as follows: 1) vulcanized fibre and lignin among the cellulosic materials; 2) Allymer C. R.-39 resin in the thermosetting field, and 3) nylon and saran among the thermoplastics.

Vulcanized fibre and lignin differ from all other materials in that the rate of deflection does not increase gradually with temperature over the whole range, but falls off at temperatures somewhat higher than that (*Please turn to page 192*)

7, 8 *and* **9**—*These curves show the changes occurring in the temperature-deflection curves of cellulose acetate, cellulose acetate butyrate and phenolic laminates, respectively, owing to modifications of the basic material by changes of plasticizer, filler, or other alterations.* **10**—*Some comparative temperature-deflection curves of plastic materials are shown in this chart*



10

Keratin—a modifier for phenolic plastics

by GEORGE H. BROTHER,* CHARLES H. BINKLEY* and BEATRICE BRANDON*

IN the development of a new plastic, it is essential, if the material is to have industrial importance, that its properties and method of fabrication compare favorably with those of established plastics and that the raw materials be readily available at reasonable cost. Standards of performance for modern plastics are so high and speed of fabrication so fast that any new material must be *good* to withstand the competition. The material described in this report has good working properties, low water absorption and improved electrical insulation properties.

The record of proteins as plastics has not been impressive. Casein is the only protein that has been accepted industrially as a plastic; and its high water absorption, poor stability and permanence and difficulty of forming except with water plasticization, has limited its field of application (7).[1] Soybean protein (5, 6, 8, 24) and cottonseed protein (30) have been studied, especially in mixtures with phenolic resin, but the results, at present, have not warranted development on a commercial basis.

All these proteins are corpuscular, according to the classification of Astbury (1) and others. Although their molecules are high polymers joined by amide linkages, the natural configuration of the molecules is roughly spherical. This configuration is not favorable to the development of strong plastic material. Experimental results have shown that it is possible to convert corpuscular proteins to fibrous proteins (21, 31). However, this work has been directed toward the preparation of fibers rather than plastics. It would appear logical to attempt the development of plastics from naturally fibrous proteins, which, by x-ray diffraction examination and other measurements, have been shown to consist of extended polypeptide-chain molecules—the configuration which appears to be essential in the molecular structure of elastomers, fibers and plastics (22). Such proteins are the keratins of which there is a number.

Keratin proteins, such as feathers, hair, hoofs and horns, are readily available and are frequently discarded as wastes. They have been investigated by other workers for plastic possibilities, and a brief outline of some of this work will be of interest. Keratins have been dissolved in aqueous caustic (32) or in sodium sulfide (25, 29) solutions, coagulated with acid, and the coagulum pressed. Horn powder has been mixed with ammonia (16) and with sulfur (17), and methods (12) and apparatus (13) for pressing horn powder have been described. Wool waste (28) has been proposed as basic material for plastics, as have horn and hoof meal (14). No plastic of importance appears to have resulted from these investigations, probably because untreated keratin is only partially thermoplastic. For this reasons untreated keratin has poor plastic flow, and material broken down by caustic or alkaline sulfide treatment is reduced to the structure and properties of animal glue.

Mixtures of keratins with synthetic resins have also been reported. Among these mixtures may be mentioned keratin and urea-formaldehyde (2, 3, 10, 15, 20, 26, 27), ivory and phenol-formaldehyde (4), horn and salicylic acid-formaldehyde (19), hydrolyzed keratin and phenol-formaldehyde (9), and horn powder and phenol-formaldehyde (18). The declared purpose of most of these was to extend the resin and thus cheapen the plastic, with little regard to the effect of the keratin on the properties. With the development of faster and better molding techniques, more efficient methods of production and improved plastics, this objective has lost most of its validity. Modification of any established plastic must improve properties or shorten the molding cycle if it is to receive consideration. Reduction in cost, if achieved, is an added incentive.

The objective of the investigation reported here was to study the effect of the addition of keratin on the flow and cure of phenolic molding powders and on the properties of the molded plastic. Three keratins were selected as typical: chicken feathers, cattle hoofs and hog bristles. All are in the category of waste products. Only one type of resin was used —a simple, acid-catalyzed, two-stage phenolic. No attempt was made to modify the keratin beyond rendering it completely compatible with the resin and improving its plastic flow. Investigations designed to improve water resistance will be reported elsewhere (11).

Experimental

A resin similar to that used in this study can be prepared according to the following formula:

Phenol	470 gm.
Formalin solution, 40 percent	335 ml.
Hydrochloric acid, 35 percent	0.8 ml.

Reflux the mixture for 1 hour. Then decant the water layer and heat the resin under vacuum until its temperature is 320° F. (160° C.).

In most of the work reported here, Resinox L-7787[2] was used. In general, its properties are similar to those of resin prepared by the formula given. Molding powders were prepared by mixing weighed amounts of resin, keratin powder, woodflour, accelerators, mold lubricants, etc., in a ball mill, milling on heated differential rolls for at least 2 min., and grinding the cooled material with a coffee mill. Investigation of the properties (plastic flow, cure time and water absorption) of a number of mixes, in which the proportion of resin and keratin was varied, led finally to the adoption of the following formulas which are to be considered as standard for this study.

	gm.	*percent*
Phenolic resin	70	35.0
Keratin	50	25.0
Woodflour	51	25.5
Titanox	18	9.0
Hexamethylenetetramine	7	3.5
Lime	3	1.5
Aluminum stearate	1	0.5

As will appear later, the properties of material prepared with this formula compare favorably with those of commercial phenolic molding powders. Increase of keratin with corre-

* Western Regional Research Laboratory, Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, United States Department of Agriculture.

[1] Numbers in parentheses refer to the list of references at the end of the article.

[2] Monsanto Chemical Co.

sponding decrease in resin tended to reduce the plastic flow and increase time of cure and absorption of water.

It was anticipated from results of earlier work (6) that phenolic-protein mixtures would take dyes more readily than the usual phenolics. Hence the white pigment, Titanox, was included in the formula to serve as background for the colors, and some good shades, lighter than those of phenolic molding materials, were produced. The amount of Titanox was reduced by the amount of dyestuff (1 to 3 gm.) added in the standard formula. Dyestuffs found to give satisfactory results were: Phenoform Blue R and Phenoform Red,[3] and Rubine A6225, Poinsettia Red A5568, Toludine Toner 3041, Maroon A4657, Orange A4414, Purple A6288, Green A6318, and Permanent Blue A4931.[4] The last produced a green instead of a blue molded product. The phenolic-keratin plastics were found to be as light-fast when colored as the regular colored phenolics, but no more so. The advantage of the phenolic-keratin mixture consists in the production of lighter, more pleasing colors by a process which is easy and economical.

Plastic flow and setting time were determined by the standard method on a Rossi-Peakes flow tester, all determinations being at 326° F. (163° C.) and 500 p.s.i. The results of tests on four commercial molding powders are given in Fig. 1 as a check on the method and for comparison with subsequent phenolic-keratin mixtures. Curves *A* and *C* were produced by colored phenolics (red and blue); curves *B* and *D*, by general-purpose phenolics. Each pair included one Bakelite and one Resinox compound.

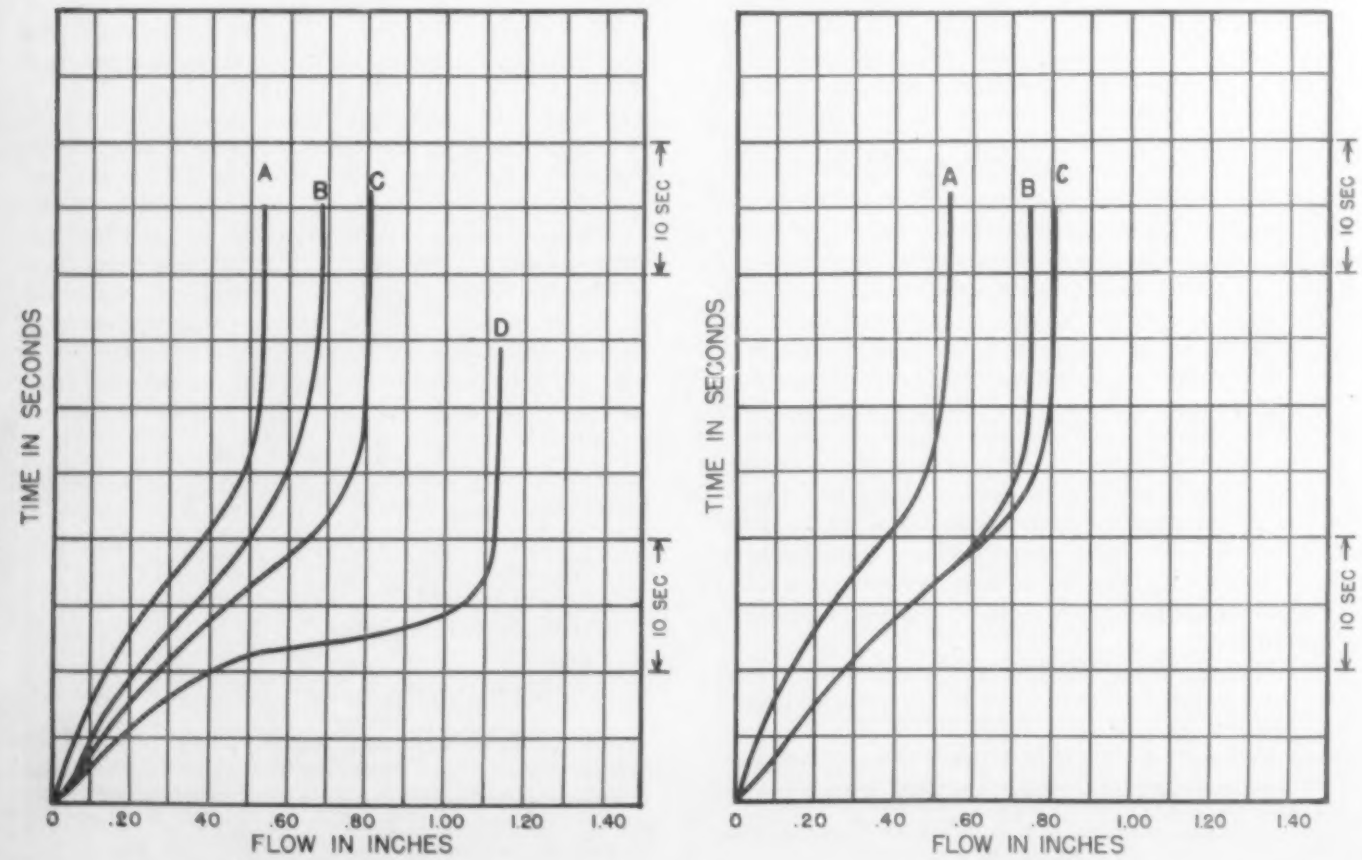
[3] General Dyestuff Corp.
[4] H. Kohnstamm and Co.

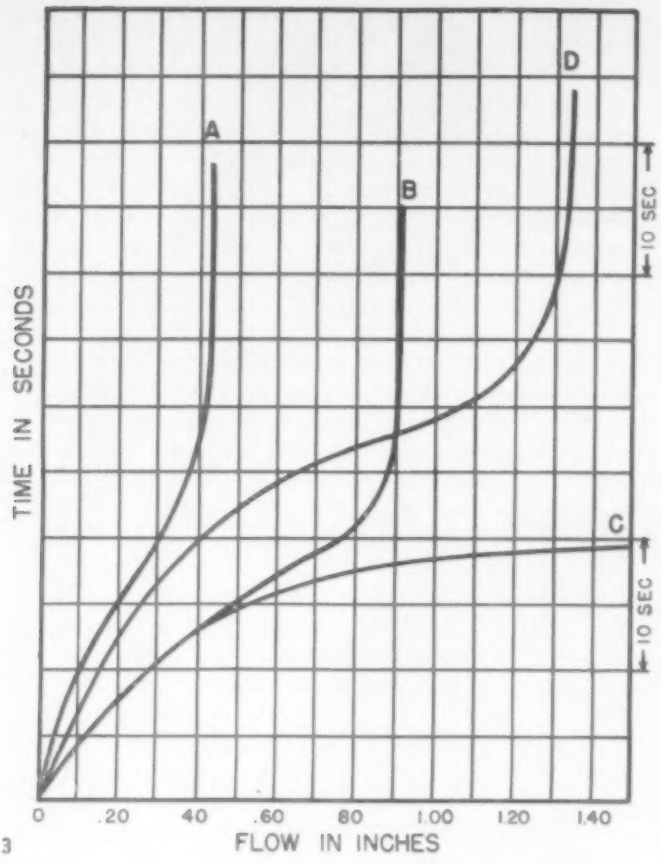
In Fig. 2, curves *A* and *C* for colored phenolics are reproduced from Fig. 1, and with them is shown the curve *B*, obtained with a colored phenolic-keratin, which from numerous tests was found to be typical when the keratin was commercial-fertilizer hoof powder. It is apparent that the flow and setting time are well in line.

The first results of this investigation—obtained with commercial-fertilizer hoof meal passed through a 100-mesh sieve to remove larger pieces and to give a uniform product—showed satisfactory flow and cure. In contrast, when feathers, hog bristles or the screened-out larger pieces of hoof meal were ground and mixed with resin and other constituents, the resulting molding powders showed reduced flow and slower cure. The fertilizer hoof meal is produced by calcining cattle hoofs as a preliminary to grinding.

The difference existing between the molding powders made from the fine and those made from the coarse hoof meal was found to lie in the fact that the fine screened powder had received adequate heat treatment ("calcination"), whereas the coarser meal had not. A study of the calcining of keratin materials was then made and the experimentally prepared keratins were used in the molding powders. It was found that keratins heated to 410–428° F. (210–220° C.) for 2 hr. were fused to a considerable extent, and analyses of feathers (23) showed a reduction in total cystine and cysteine content from 3.88 to 0.66 percent, which may be taken as evidence of destruction of S-S bonds in the molecules. Molding powders made with this calcined keratin showed an increase in plastic flow from only 40 to more than 150. In order to measure flow more accurately, a mixture containing more

1—Flow curves of commercial phenolic molding powders: A and C—colored; B and D—general-purpose. 2—Comparison of plastic flow of phenolic and phenolic-keratin molding powders: A and C—colored phenolic; B—colored phenolic keratin





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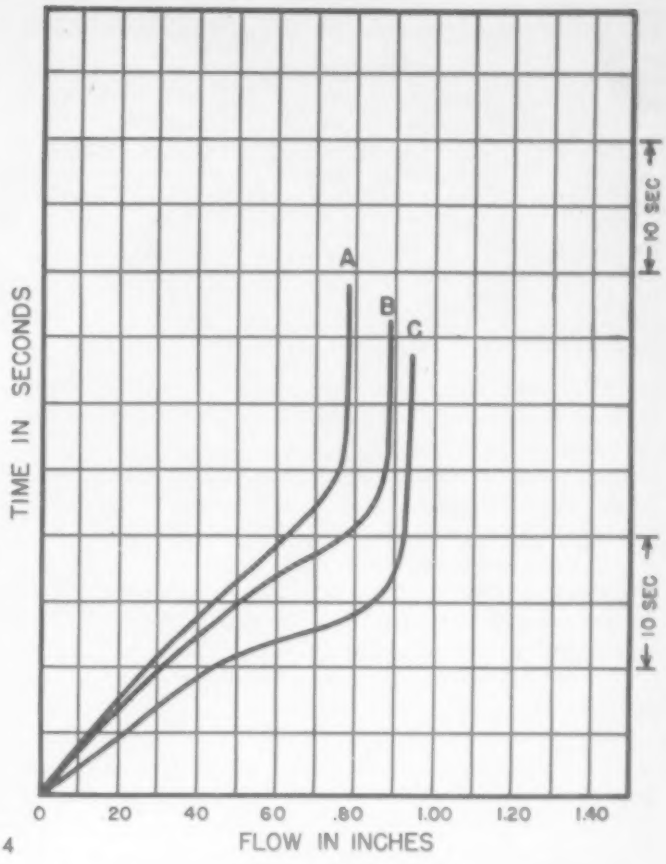

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3—Effect of calcined keratin on flow of phenolic-keratin molding powder. A contained untreated keratin; B, keratin heated 1 hr. at 410–428° F.; C, keratin heated 2 hr. at 410–428° F.; D, highly calcined keratin plus woodflour. 4—Flow curves A, B and C for phenolic powder modified with calcined hoof meal, chicken feathers and hog bristles respectively.

woodflour was made up for testing purposes. The formula was as follows:

	gm.	*percent*
Phenolic resin	70	30.6
Keratin	50	21.8
Woodflour	80	34.9
Titanox	18	7.9
Hexamethylenetetramine	7	1.3
Lime	3	3.1
Aluminum stearate	1	0.4

Molding powders made with keratins that had been calcined less drastically than those just described were found to have flow properties intermediate between those of the untreated and the fused keratin. The same effect could be produced by mixing different proportions of the highly calcined material with untreated or more moderately calcined keratin. For example, a product of satisfactory flow resulted from calcining the larger pieces separated from commercial-fertilizer hoof meal at 410° F. (210° C.) for about 1 hr. grinding and mixing with the sieved powder in about a 25:75 ratio.

The rate-of-flow curves of Fig. 3 show clearly the effect of calcining of the keratin upon the flow properties of the phenolic-keratin plastic. Curve *A* was obtained with powder containing untreated keratin; curve *C*, with powder containing keratin heated 2 hr. at 410–428° F. (210–221° C.); curve *B*, with powder containing keratin heated 1 hr. at 410–428° F. (or a mixture of *A* and *C* materials); and curve *D*, with powder containing highly calcined keratin plus additional woodflour in the formula (e.g., with the modified formula listed previously). It should be stated that, although the plastic flow of this latter combination was good, the setting time was the longest of any plastic tested.

In order to compare the three keratins (chicken feathers, hog bristles and hoof powder) with regard to effect on phenolic molding mixtures, they were calcined at the same temperatures, and mixtures of standard-formula molding powder were made up. The results of plastic-flow tests are shown in Fig. 4, in which curve *A* represents the mixture containing hoof powder, curve *B* the one containing chicken feathers, and curve *C* the one containing hog bristles. From these curves it would appear that the hog bristles gave somewhat the best molding material with regard to both flow and time of set, but the differences were within limits of experimental factors.

Time of cure was determined with a cure-test cup $2^1/_2$ in. high, $1^3/_4$ in. in bottom diameter and 2 in. in top diameter. Maximum temperature possible with available equipment was 320° F. (160° C.), and actual temperature within the die was probably somewhat less. Under these conditions, commercial phenolic molding powders averaged 3 min. for curing time, while the phenolic-keratin molding powders averaged about 6 minutes. However, reports from three custom molders who examined the powder, stated that the cure was satisfactory and required but little more time than that needed but regular phenolics. Their tests were probably conducted at higher temperatures, which are known to be more favorable for satisfactory molding of phenolics.

Water absorption was determined with completely cured disks, 2 in. (5.08 cm.) in diameter and $^1/_8$ in. (0.32 cm.) thick, in accordance with A.S.T.M. Method D 570–42. The molding cycle for the disks was long enough to insure complete cure. The disks were then conditioned for 24 hr. in an oven

TABLE I.—WATER ABSORPTION (24 HR.) OF KERATIN-MODIFIED PHENOLICS

Keratin treatment	*Water absorption of disks made with:*		
	Hoof meal	*Hair*	*Feathers*
	percent	*percent*	*percent*
Native	0.62	0.81	0.83
Partially calcined	0.57	0.60	0.55
Completely calcined (melted)	0.48	0.48	0.29
Completely calcined with added woodflour	0.50	....	....

at 122° F. (50° C.), cooled to room temperature in a desiccator, and weighed. They were immersed in distilled water at room temperature for 24 hr., roughly dried, and again weighed. Gain in weight, calculated to percentage gain over the original dry weight, is reported as water absorption. Weights after reconditioning showed no appreciable loss by extraction. Blanks on commercial phenolic molding powders gave water absorptions of 0.25 to 0.40 percent. Water absorption values for the phenolic-keratin disks are shown in Table I; they varied with the keratin used and its treatment.

It is not possible at this time to offer a very satisfactory explanation for these variations, which appear to be consistent; all data are averages of three or more determinations in which the differences were small. However, the effect of heat on the structure and reactions of these materials is under investigation and it is hoped that the results will explain the variations. It may be stated now that the increase in water absorption as a result of adding keratin material to phenolic plastic, especially in mixtures containing calcined keratin, was less than in any phenolic-protein molding powder previously reported and, further, that in all cases the amount was insufficient to impair the stability and the permanence of the finished product.

A few flexural strength (modulus of rupture) and impact strength tests were made in accordance with A.S.T.M. Methods D 650–42 T and D 256–43 T, respectively, but the curing conditions used in preparing the test bars were so unsatisfactory that the results cannot be regarded as conclusive. To cure a test bar $^1/_2$ by $^1/_2$ by 5 in. in dimensions with a maximum platen temperature of 320° F. (160° C.) and maximum mold temperature 10 to 20° F. lower is a slow and very uncertain procedure. Bars of commercial phenolic molding powders gave averages of around 12,000 p.s.i. for flexural strength and 0.30 ft.-lb./in. of notch for impact strength. Tests on the phenolic-keratin molding powders, all of which were prepared with fertilizer hoof meal passing a 100-mesh screen, averaged about 10,000 p.s.i. for flexural strength and about 0.30 ft.-lb./in. of notch for impact strength.

Probably the largest single field of application for phenolic molded material is that of electrical insulation. Structural insulation members, such as parts of ignition distributors, motor housings and the like, can be easily and economically produced from phenolic material. Although they have good electrical insulation properties, they are handicapped by one weakness. When an electric arc flashes between two poles molded into phenolic, the arc quickly burns a carbon path or "track" across the surface of the plastic along which the current can then travel. The insulating efficiency of the phenolic piece is thus destroyed.

Comparative tests were run with commercial phenolics and the phenolic-keratin plastic to determine their arc resistance, or tendency to "track." The test pieces were 2-in. disks, such as those used for water-absorption tests. However, instead of being conditioned at an elevated temperature they were exposed to normal room conditions for at least 6 days before being tested. The test was made according to A.S.T.M. Method D 495–42, with electrode mounting as specified and a spark gap of 0.320 in. (0.813 cm.). The current was 10 milliamps., with a voltage of 10,000 v.; the timing cycle was manually operated and hence not absolutely uniform or accurate. A uniform timing cycle would have tended to show an even greater difference between the two types of material. The regular phenolic plastic broke down on the first or second spark cycle and never survived more than two cycles. The phenolic-keratin plastic survived 4 to 10 cycles before failure. In every case the superiority of the phenolic-keratin over the regular phenolic plastic was very marked. For further comparison, disks of urea-formaldehyde and melamine-formaldehyde plastics were also tested. These were known to have high arc resistance, and this fact was confirmed by the test. They were much superior to both the phenolic and the phenolic-keratin plastic.

Summary

Readily available, low-cost or waste keratins such as feathers, hoofs and hair, can be used, after simple and economical treatment, to modify phenolic molding powders. The modified powder can be prepared by the same method and in the same equipment as used for the preparation of unmodified phenolic-resin molding powders. It has practically the same flow properties as general-purpose phenolics; hence it is readily adapted to standard molding procedure and equipment, but may require a somewhat longer molding cycle to insure cure. The finished molded product absorbs somewhat more water than do the molded products of most phenolics, but not enough more to be out of line. Its flexural strength is about 15 percent less than that of unmodified phenolic plastic, and its impact strength is about the same. The phenolic-keratin plastic can be produced in a wider range of colors than is practicable with the phenolics, and its arc resistance is at least two to three times as great. In addition, lower material costs would result from the replacement of a portion of phenolic resin by the lower-cost keratin.

Acknowledgment

The authors wish to thank T. M. Shaw of this laboratory for conducting the tests on arc resistance, and C. B. Jones, also of this laboratory, for determinations of cystine and cysteine in feathers. Monsanto Chemical Co. and Bakelite Corp. supplied phenolic resin and molding powders. General Dyestuff Corp. and H. Kohnstamm Co. supplied dyestuffs. Waterbury Companies Inc., Chicago Molded Products Corp. and Autopoint Pencil Co. tested the phenolic-keratin molding powder under the operating conditions of custom molders. The cooperation of these companies is gratefully acknowledged.

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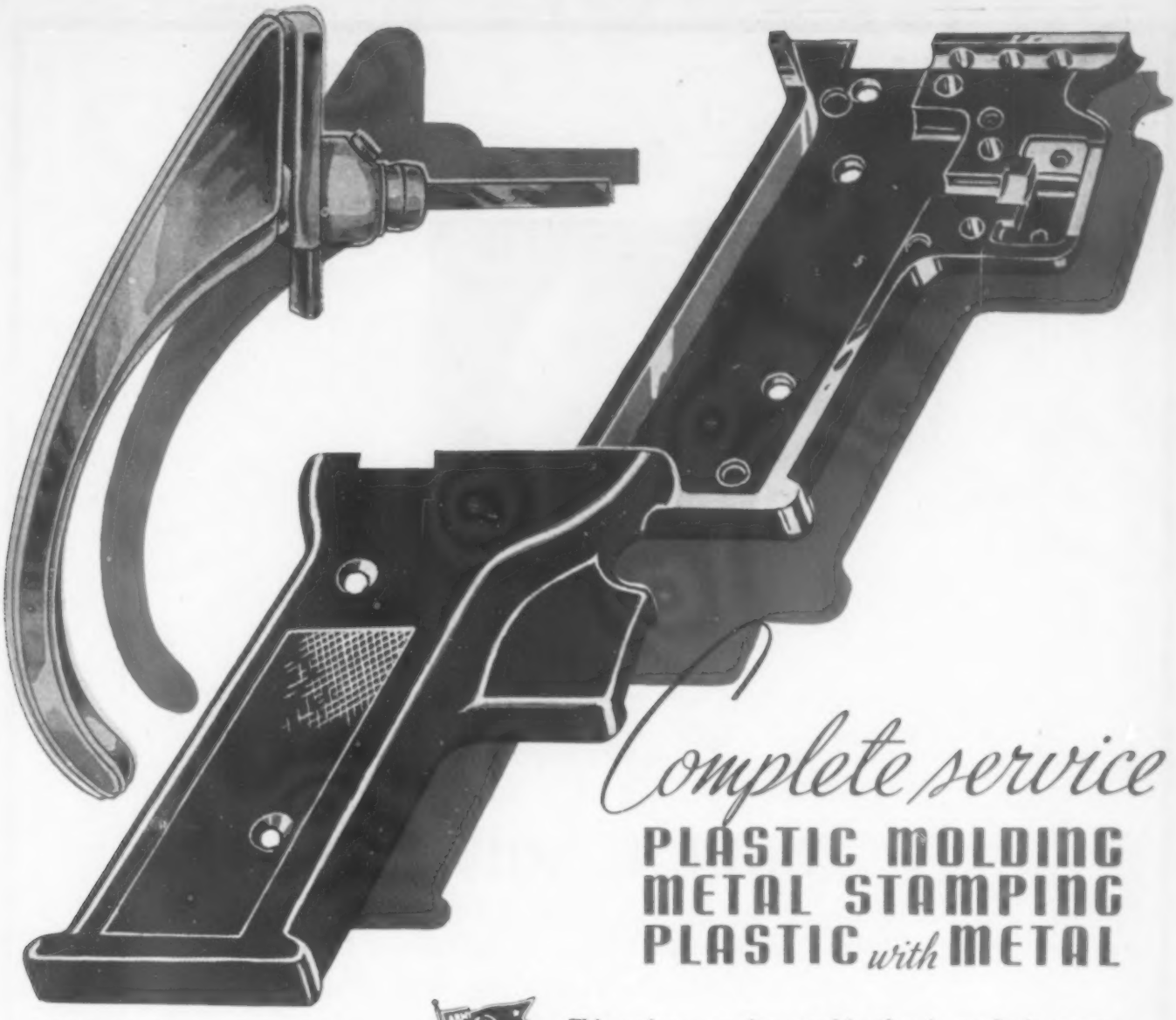

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With the passing of Earl F. Lougee on January 14, 1945, the plastics industry lost one of its most progressive leaders. We who knew him best will feel his loss the most. His fine personality, his gracious approach to all problems and his sincere devotion to the building and advancement of the plastics industry won for him the friendship and admiration of all. This page we dedicate to his memory.

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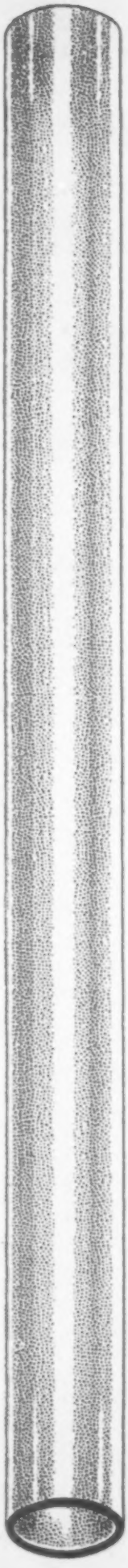

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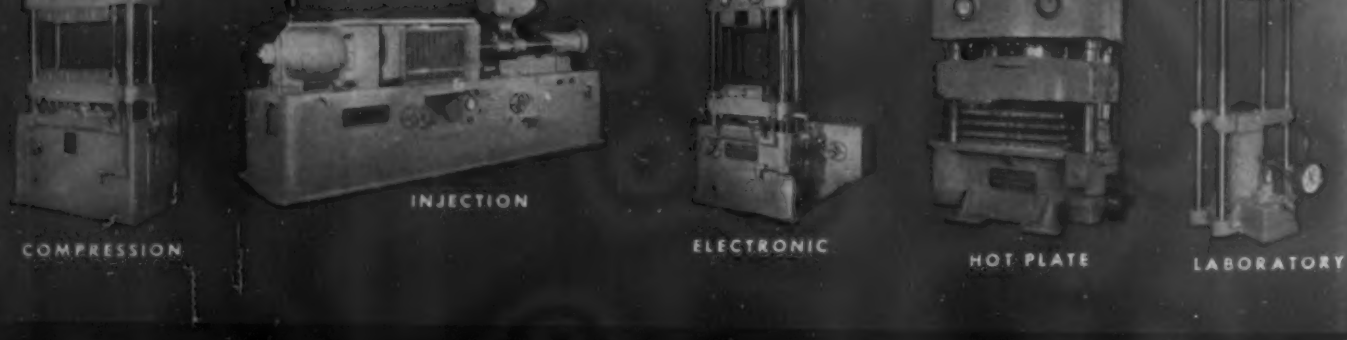

TECHNICAL BRIEFS

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments.

Engineering

WEATHERING QUALITIES OF PLYWOOD GLUES. R. A. G. Knight. Wood *9* (June 1944). Plywoods bonded with various adhesives were exposed out-of-doors for nearly three years. One group of specimens was exposed on a wall facing southeast; a second group was half-buried in the ground; the third group was half immersed in water. The phenol-formaldehyde resin adhesives proved to be the most durable, followed by the urea-formaldehyde resin adhesives, and the urea-formaldehyde resins extended with not more than 25 percent flour. The urea-formaldehyde resin extended with 50 percent or more flour, blood albumin, casein and starch adhesives were found to be unsuitable for these exposures. The addition of low concentrations of certain toxic compounds to the non-durable glues was found to have only a slight effect on their life. The durability of plywood adhesives may be evaluated from the results of mycological tests and the wet-dry strength ratio. To be considered durable, the loss in strength must not be appreciable in non-sterile mycological tests and the wet-dry strength ratio must be greater than 80 percent.

LAMINATION — METHODS AND EQUIPMENT. O. De Sylva. Modern Packaging *17*, 117–22, 150 (Aug. 1944). The methods and equipment for laminating plastic film, paper, cloth and metal foil are described.

THE BEHAVIOR OF WOOD-FLOUR-FILLED PHENOLIC PLASTICS IN HOT HUMID CLIMATES. H. Gerland. Siemens-Z. *23*, 23-7 (1943); Chem. Abstracts *38*, 6006 (Nov. 10, 1944). Acetic acid and ammonia are formed by decomposition of wood-flour-filled phenolic plastics which are exposed to hot humid conditions. These products corrode metal inserts and nearby metal parts. Wood-flour made from spruce produces the least corrosion. Satisfactory plastic compositions contain at least 50 percent resin, a large portion of magnesium oxide and no excess of hexamethylenetetramine. Accelerators which do not liberate ammonia are satisfactory. The acetic acid content should not exceed 0.18 percent and the ammonia 0.15 percent.

TOLERANCES FOR PLASTIC MOLDED SCREW THREADS. Plastics (London) *8*, 569–72 (Dec. 1944). The factors involved in determining the tolerances for threads in molded plastic articles are reviewed. Suggestions for standards are discussed.

THE TREND OF WOOD USE IN AIRCRAFT. R. W. Hess. Aeronautical Eng. Rev. *3*, 9–15, 29 (Dec. 1944). The present use of wood in aircraft construction is reviewed and summarized. The greatest deterring factor in the use of wood for aircraft is the fact that most engineers have had little or no training in its use. The difficulties are increased by the directional properties of the material and the lack of sufficient engineering data on plywood and laminate combinations and shapes. By proper design, failures caused by stress concentrations and hygroscopicity which are particularly troublesome in wood structures can be minimized. The advantages of wood structures are: better appearance, saving in weight, saving in cost, more rigid airfoil sections, good vibration damping characteristics, soundproofing and good insulation characteristics. The adhesives, bonding methods and forming methods for making plywood and other wood-plastic combinations and shapes are discussed. Recent developments in adhesives for wood and for wood to metal will result in improvements in wood structures. Possible applications of wood, plywood and other wood-plastic combinations in aircraft construction are discussed.

Chemistry

SYNTHETIC RESIN DESIGN. A. G. Chenicek. J. Chem. Education *21*, 495–501 (Oct. 1944). The fundamental molecular structures encountered in synthetic resins are reviewed. Generalizations are presented by means of which resins may be classified as elastomers, plastics or fibers. There is an urgent need for the evaluation of the various structural units in engineering terms so that the trial and error method of synthesis may give way to a more rational method of making the structures with the desired properties. The concept of functionality is one key to this problem but others are also needed.

EQUILIBRIUM DISTRIBUTION IN SIZES FOR LINEAR POLYMER MOLECULES. A. V. Tobolsky. J. Chem. Phys. *12*, 402–4 (Oct. 1944). Systems of linear polymer molecules are characterized by favorable heats of polymerization and counterbalanced by unfavorable entropies of polymerization. Long chains are therefore formed and are stable at low temperatures, while at sufficiently high temperature appreciable amounts of monomeric units split off. At any given temperature there exists a definite equilibrium distribution in sizes. This distribution is derived by statistical methods and is a very simple function of the heat of polymerization.

MIGRATION VELOCITY OF FOREIGN IONS IN SYNTHETIC RESINS. R. Houwink. Kunststoffe *34*, No. 2, 25–6 (1944); Chem. Abstracts *38*, 5449 (Oct. 20, 1944). Synthetic resins may be divided into two groups on the basis of their electrical conductivity behavior. One group includes those which have an intrinsic conductivity such as Perbunan and conductivity rubber. The other group includes those which conduct as a result of migration of foreign ions such as phenolic resins and polyvinyl chloride. The theory is advanced that the migration velocity of the ions follows an equation of the type $P\text{-}DL$, where P is the permeation coefficient, D is the diffusion coefficient and L is the solubility constant. D is proportional to the activation energy.

ASSOCIATION AND SOLVATION OF CELLULOSE ACETATE. M. Takei. Kolloid-Z. *101*, 129–35 (1942); Chem. Abstracts *38*, 5449 (Oct. 20, 1944). The viscosity of solutions of cellulose acetate in various solvents was measured. The results are discussed in terms of the equations developed by Takei and Erbring. The significance of two of the constants in these equations is discussed. One constant depends on the degree of solvation and immobilization and the other on association.

ACETYLATED CASEIN FIBER. A. E. Brown, W. G. Gordon, E. C. Gall and R. W. Jackson. Ind. Eng. Chem. *36*, 1171–5 (Dec. 1944). Casein fiber as ordinarily hardened with formaldehyde is inferior to wool as a textile fiber because of its lower tensile strength, especially when wet, and because of its poor resistance to boiling, particularly in mildly alkaline solutions. An investigation was made to determine whether the acetylation of casein fiber would improve the inferior properties of the protein fiber. Acetylation was carried out with acetic anhydride under various conditions, including the presence of catalysts. Acetyl contents from 1.0 to 9.0 percent

were obtained by varying the time and temperature. Correlations between acetyl content and various properties are reported. Acetyl contents of about 6 percent or less can be introduced with no loss of wet or dry tensile strength. Fibers with acetyl contents above 6 percent had lower dry and wet tensile strength. Fibers of 6 percent acetyl content are superior to the untreated control fiber in regard to resistance to boiling solutions simulating dye-bath conditions. They also have the desirable property of a greatly decreased affinity for acid dyes, i. e., dyes with colored anions, and thus more closely approximate wool in dye uptake.

THE EFFECTS OF TEMPERATURE ON THE POLYMERIZATION OF STYRENE. S. G. Cohen. J. Am. Chem. Soc. *67*, 17–20 (Jan. 1945). The rates of decomposition of benzoyl peroxide in 3.46 molar solutions of styrene in benzene were determined at 54, 64 and 74° C. The polymerization of the styrene was studied at the three temperatures at equal rates of peroxide decomposition. The rates of polymerization and the molecular weights of the products increased under these conditions with rise in temperature of reaction, the rates rising more rapidly than the molecular weights. The activation energy of the chain growth reaction was estimated to be 11 kcal. This calculation was based on the approximation that at equal rates of peroxide decomposition at several temperatures there are equal rates of chain initiation. It is concluded that, in the peroxide catalyzed polymerization of styrene, the molecular weight is determined largely in a reaction of lower activation energy than that of chain growth, and chain transfer reactions are of minor importance. This is in agreement with other investigators' conclusions as to the mechanism of this reaction.

Properties

WATER-VAPOR PERMEABILITY OF MOISTURE-SENSITIVE MATERIALS. G. J. Brabender. Paper Trade J. *119*, 52–5 (Oct. 19, 1944). A composite sheet material such as moisture-proof triple-ply glassine offers particular difficulty in the determination of its water-vapor permeability by accelerated methods. The cellulose matter in such a sheet has a marked tendency to absorb water whereas the two films of micro-crystalline wax act as effective barriers to water-vapor transfer. This type of construction demands that special attention be paid to the factors of 1) sheet distortion on the test cell, 2) the prolonged period before the sheet reaches equilibrium with the testing conditions, and 3) a low rate of change in weight due to true water-vapor transfer. Precise control over the atmospheric conditions within the testing cabinet is of definite importance. Certain advantages in making permeability tests were found by using a lightweight test cell made as a shaped, seamless metal ring having two open faces. Test assemblies made up with such cells have a low gross weight, a small volume of confined air, occupy a small space in the cabinet, tend to minimize sheet distortion and provide a fairly large test area. Ordinary rosin is not recommended as a component in the sealing medium for water-vapor permeability tests because of its tendency to gain weight under high humidity and temperature conditions. This gain in weight is probably due to both oxidation and moisture absorption. Certain microcrystalline waxes and specially treated rosins were found to be free from these defects and to have other suitable properties for use in sealing compounds.

TOLERANCES AND SHRINKAGE OF INJECTION-MOLDED PARTS. J. Hemmersbach. Kunststoffe *34*, No. 2, 33–6 (1944); Chem. Abstracts *38*, 5325 (Oct. 10, 1944). The contraction and swelling characteristics of several types of superpolyamides were measured. At 50° C., the shrinkage of the superpolyamides varies from 0.3 to 0.4 percent. On immersion in water, the expansion varies from 0.15 to 0.9 percent.

THE DENSITY OF CELLULOSE. W. Moll. Chemische Tech. *1943*, No. 47, 105–11; Chem. Abstracts *38*, 6091 (Nov. 10, 1944). The density of regenerated cellulose as determined by pycnometer and gasometric methods was found to be 1.52 g./cm.^{3} The density is independent of degree of polymerization, concentration in viscose and degree of stretch. Precipitation conditions and drying methods affect the density. Slow precipitation and drying give products of high density.

WATER-VAPOR PERMEABILITY OF ORGANIC FILMS. P. M. Doty, W. H. Aiken and H. Mark. Ind. Eng. Chem. Anal. Ed. *16*, 686–90 (Nov. 1944). An apparatus for a rapid, precise and reproducible determination of water-vapor permeability is described. Two factors, diffusion velocity and solubility, together determine the vapor permeability of a film. Both can be derived from the measurements. Equations based on the validity of Fick's law are tested with commercial films of low permeability. The dependence of permeability on thickness, vapor pressure and temperature is studied. Except for films which contain hydrophilic materials or for films made of materials that sorb much water, the permeability constant is independent of thickness, i. e., the permeability is inversely proportional to the thickness. The permeability of a good film approximately doubles for a 10° C. rise in temperature. On the basis of measurements of a number of films, a discussion of the process of permeation is presented. The permeability, diffusion and solubility constants for cellophane, polyvinyl chloride, nylon, polythene, rubber hydrochloride, polyvinylidene chloride, ethylcellulose, glassine and vinyl-chloride acetate copolymer films are reported.

CHEMICAL PROPERTIES OF PLASTICS AFFECT DESIGN OF PARTS. W. S. Larson. Product Eng. *15*, 845–8 (Dec. 1944). The effect of various reagents on the weight, dimensions, appearance and strength of molded phenolic, paper-base laminated phenolic, urea-formaldehyde, methyl methacrylate, polystyrene, vinyl chloride acetate, cellulose acetate, cellulose nitrate and ethyl cellulose plastics is reported. The results are discussed in relation to the applications of the materials.

Testing

IMPACT-STRENGTH TESTING. A. Schwittmann. Kunststoff-Tech. u. Kunststoff-Anwend. *12*, 286–8 (1942); Chem. Abstracts *38*, 5616 (Oct. 20, 1944). The Charpy, Izod and Zebrowsky methods for determining impact strengths are discussed.

DETERMINATION OF MOISTURE-VAPOR TRANSMISSION OF PACKAGING MATERIALS. L. Boor and J. K. Dixon. Paper Trade J. *119*, 26–34 (Nov. 2, 1944). Application of the Permeameter which was developed to measure permeability of balloon fabrics to hydrogen to the measurement of water-vapor transmission is described. Certain modifications required to make this adaptation are given in detail and their effects are discussed. A systematic comparison was made of the various methods used for measuring water-vapor permeability; the methods included are the Payne-cup method, pie-plate method (similar to the General Foods moisture-vapor transmission test), the TAPPI standard method, and the Institute of Paper Chemistry method. The data given indicate that the Permeameter can be used to measure the permeability of cellophane, glassine, treated papers, paper-metal laminates, ethylcellulose film and rubber hydrochloride, and possesses certain advantages over the other procedures. The method is suitable for measuring substances which have permeabilities in the range of 1.5 to 150 g/m^2/24 hr. The time required for testing is of such short duration that the instrument can be readily adapted for control purposes.

APPLICATION OF THERMOCHEMISTRY TO THE FIELD OF HIGH-POLYMER SUBSTANCES. W. A. Roth. Kautschuk *19*, 1-2 (1943);

Chem. Abstracts *38*, 6128 (Nov. 10, 1944). The iodine values, softening temperatures and heats of combustion of rubber and butadiene copolymers are compared. The determination of specific heats of high polymers is discussed. Methods of obtaining the heats of wetting, heats of swelling and heats of vulcanization are outlined.

TESTING THE ADHESION BETWEEN LAYERS OF LAMINATED PLASTICS. W. Weigel. Kunststoffe *34*, No. 4, 76 (1944); Chem. Abstracts *38*, 6005-6 (Nov. 10, 1944). A cantilever machine for applying a bending stress simultaneously to all layers of a rod-shaped specimen is described.

LABORATORY TESTER FOR PLASTIC BEARINGS. H. Conradt. Kunststoffe *34*, No. 4, 79–81 (1944); Chem. Abstracts *38*, 6006 (Nov. 10, 1944). A friction balance is described for testing plastic bearings of normal design.

ELECTROSTATIC PROPERTIES OF RUBBER AND GR-S. R. S. Havenhill, H. C. O'Brien and J. J. Rankin. J. Applied Phys. *15*, 731–40 (Nov. 1944). A new electrostatic modulator for measuring the electrostatic charges on various materials is described. In this apparatus the electrostatic lines of force established between the charged specimen and the grid of an audiofrequency amplifier are cut or modulated at audiofrequency by a motor-driven fan. The resultant alternating current voltage is amplified and measured on a meter in the output circuit. This device, in conjunction with a mirror-surfaced metal plunger system for contacting the sample, was used to measure the contact potential of various rubber and GR-S compounds. Data are reported for both rubber and GR-S compounds. An electrostatic contact potential theory of reinforcement is advanced in which reinforcement is explained on the basis of contact potentials and resultant electrostatic forces set up between the rubber and the reinforcing agents. The greater the difference in potential between the rubber and the reinforcing material, the greater the reinforcement. By the application of this theory, organic materials which have a highly positive charge, such as polymerized trimethyldihydroquinoline and an acetone-aniline condensation product, were found to increase the tensile of GR-S pure gum-type compounds as much as fivefold and to nearly double the tensile of high zinc oxide GR-S compounds.

MEASUREMENT OF THE THERMAL CONDUCTIVITY OF PLASTICS. Plastics (London) *8*, 564–8 (Dec. 1944). This is a translation of an article by F. Gottwald in Archiv für Technisches Messen, May 1943. The methods for measuring the thermal conductivity may be classified as static or dynamic according to the technique employed. Three static methods and two dynamic methods suitable for measuring the thermal conductivity of plastics and other poor conductors, 0.1 to 0.8 kcal/hr.-m-°C, are described. Thirteen references are given.

Synthetic rubber

GUAYULE RUBBER. H. R. Smith. Chem. and Met. Eng. *51*, 122–3 (Oct. 1944). The process for extracting rubber from guayule shrubs is described. New developments in process methods have improved both the efficiency of extraction and the quality of the final product.

A LOW-TEMPERATURE STIFFNESS TEST FOR ELASTOMERS. R. E. Morris, R. R. James and E. R. Evans. India Rubber World *110*, 529–32 (Aug. 1944). A method for determining the low-temperature stiffness of elastomers is described. The advantages of the new method are: 1) set may be determined as well as stiffness; 2) the test specimens are very small and can be prepared readily from almost all rubber goods; 3) air is used as the cold transfer medium instead of alcohol, which swells some elastomers; 4) the cold-generating apparatus can be relatively simple and can be built from inexpensive materials, or it can be purchased commercially; 5) the stiffness-measuring apparatus is simply constructed, and its manipulation is very easy; 6) the stiffness-measuring apparatus employs a weight for application of load to the test specimens instead of a spring; therefore there is no need of frequent calibration as when a spring is used; and 7) the precision of the method is believed to be at least as high as the precision of other cold-stiffness tests. The results of tests made on several natural- and synthetic-rubber compositions are reported.

THE EFFECT OF TEMPERATURE ON THE VIBRATION CHARACTERISTICS OF NATURAL AND SYNTHETIC RUBBERS. J. D. Morron, R. C. Knapp, E. F. Linhorst and P. Viohl. India Rubber World *110*, 521–5 (Aug. 1944). The stress-strain characteristics, tensile strength, elongation and vibration transmission at various temperatures and the brittle points of several natural and synthetic rubber compositions were determined. The results of this work show that the effect of temperature on the functions of vibration insulators is much greater than would be supposed from the type of tests which have become more or less common in the industry for determining the effect of low temperatures on various elastomers. Natural rubber is the outstanding material for vibration insulation at subnormal temperatures. The substitution of any of the synthetics for natural rubber is a problem which requires not only a thorough study of compounding, but also of the practical conditions under which the particular mounting or insulator is supposed to function. An improvement in vibrations insulation over a wide range of temperatures may be obtained by means of increased initial deflection. A critical point, called the "barrier point," which is dependent not only upon the compound, but upon the design and application of the mounting, is defined. New laboratory methods were devised to obtain information which design engineers can apply to practical problems. This equipment actually shows the percentage of transmission of vibration. New equipment for the determination of stress-strain curves and tensile tests at all temperatures are likewise described and their uses explained.

AN EVALUATION OF PLASTICIZERS FOR PERBUNAN. R. E. Morris, J. W. Hollister and I. P. Seegman. Rubber Age *56*, 163–7 (Nov. 1944). Twenty-six plasticizers and two plasticizer blends were evaluated for use with Perbunan. The properties studied include tensile strength, modulus at 500 percent elongation, ultimate elongation, weight loss on heating, Shore hardness, rebound resilience, compression set, extensibility at 80° F. and at –20° F. (initial and after oven aging) and recovery at –20° F. The main purpose was to evaluate the low-temperature characteristics of the plasticizer-Perbunan compositions. The outstanding plasticizers for this purpose are tributoxyethyl phosphate and triglycol dioctylate; their effect on other properties is not exceptional.

AROMATIC HYDROCARBON COMPOUNDING MATERIALS FOR GR-S. L. M. Geiger. India Rubber World *111*, 312–17 (Dec. 1944). The variation of physical properties of GR-S compounds with the 3 major classes of aromatic hydrocarbons was investigated. Superior results were obtained with medium-hard coumarone-indene resins in non-carbon black compounds; the apparent vulcanization retarding effect by the use of a coumarone-indene polymer in which sulfur was dissolved was observed. Data on the improvement in fatigue of GR-S by using increased amounts of coal-tar distillate softener and of carbon black are given. Reference is made to the releases from the Office of Rubber Director, WPB, covering numerous types of stocks; and the corresponding class of softener and type of filler is listed. These data and descriptive comments clarify the picture of the comparative uses of the various classes of aromatic hydrocarbon softeners.

PLASTICS DIGEST

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals directly to publishers.

General

PENETRATION OF PACKAGING MATERIALS BY INSECTS. E. O. Essig, W. M. Hoskins, E. G. Linsley, A. E. Michelbacher and R. F. Smith. Modern Packaging *17*, 109–13 (July 1944). With some insects, penetration of package materials which are permeable to odors is apparently favored by the presence of food. Those insects with propensity for boring are apparently the best penetrators of packaging materials. At least one stage of each of the common stored food pests, except the saw-toothed grain beetle, was able to penetrate some of the materials tested. None of the commercially used metal-substitute packaging materials tested is strictly insect proof. An abrasive paper is still under test. The most promising type of material thus far tested was a heavy cardboard carton double-dipped in a thermoplastic material. Among the more promising transparent cellulose materials are such products as Thermophane *A* and Cellophane 600. However, these materials are only relatively more resistant to penetration than most lightweight materials tested. Laminated kraft-asphalt-lead-foil-cellophane bags showed little resistance to insect penetration. Among the multiwall bags, the Bemis bag was the most promising. However, it was readily penetrated by the cadelle. Manufacturing techniques are needed which will produce uniform containers without roughened spots, creases, folds and similar areas where insects penetrate most easily. Repellents offer a possible solution to the problem of keeping insects out of packaged food. Toxicity is shown by many compounds, especially phenol derivatives, and effects due to repellency obscured.

PAINTS AND VARNISHES—RECENT ADVANCES WITH POST-WAR PROMISE. Chem. & Met. Eng. *51*, 119–124 (Nov. 1944). This is a review of advances in the paint and varnish industry during the war period. Chief among them are the following: 1) development of dehydrated castor oil as a substitute for imported tung oil; 2) industrialization of methods for producing conjugated fatty acids by catalytic isomerization; 3) intensified use of alkyd and modified alkyd resins; 4) development of polyhydric alcohols for use in place of glycerol in alkyd-type resins; 5) development of soybean-oil-base alkyds for non-yellowing interior paints; 6) marketing of improved types of titanium base pigments; 7) development of high-polymer synthetic resins in protective coatings; 8) development work on synthetic bristles for paint brushes; 9) improvements in water-thinned paints, especially those of the resin emulsion type; 10) improvements in design of varnish kettles and other equipment; 11) development of a vast number of finishes for specialized uses, particularly for military purposes and as industrial protective coatings; 12) new and improved methods of application or finishing, especially in industrial fields; 13) efforts to develop natural drying oils that can be produced in this hemisphere; and 14) industrialization of processes for fractionation of natural oils and fatty acids.

DEPARTMENT AND DRUG STORES DEMAND COMPETITIVE PRICE AND QUALITY FROM PLASTICS. Pacific Plastics *2*, 15–20 (Nov. 1944). This is a report of a survey of the department and drug store outlets in the West Coast area dealing with plastics products which these stores offer for sale and other plastics application which are used in the operation of these outlets. To take advantage of the opportunity for plastics in the postwar era, it is necessary that manufacturers of plastic products learn quickly: 1) the basic factors of price and quality, 2) the necessity of working with the retailers in the development and styling of new merchandise, 3) the need of providing store sales forces with adequate information, 4) the importance of labeling merchandise for the education of the consumer.

Materials

RAG CONTENT PAPER FOR PLASTICS. W. G. Hendrich. Paper Trade J. *119*, 31–2 (Aug. 31, 1944.) The various properties of rag content papers to be considered when the paper is intended for use in the manufacture of laminated plastics are discussed. Papers suitable for various types of laminates can be made. The properties of the paper which can be varied are weight, caliper, porosity, apparent density, formation, tensile strength, stretch, tear strength, absorption, bursting strength, wet strength, addition of pigments and resins, grain and uniformity.

ALKYD RESINS FROM PENTAERYTHRITOL. A. A. Blagonravova and M. A. Antipova. J. Chem. Ind. (U. S. S. R.) *18*, No. 9, 16–17 (1941); Chem. Abstracts *38*, 5023 (Sept. 20, 1944). Good lacquer resins are made by the following series of reactions: 1) linseed and sunflower oils are heated with pentaerythritol at 220° C. in the presence of an alkaline catalyst. 2) The product is next heated with phthalic anhydride at 240° C. until 13 to 20 percent of the anhydride has reacted. 3) Finally, the polymerization is completed by heating at 250 to 260° C. for 3 to 5 hours.

OBTAINING ARTIFICIAL RESINS BY A CONTINUOUS PROCESS. Y. G. Popandopulo. J. Chem. Ind. (U. S. S. R.) *18*, No. 12, 16–18 (1941); Chem. Abstracts *38*, 5022 (Sept. 20, 1944). A mixture of phenol, formaldehyde and an acid catalyst is forced by nitrogen gas at 4 atmospheres through a series of tubes which are immersed in an oil bath maintained at 130 to 140° C. The resin is pulled from the container by applying a vacuum. The specific heat of a phenol-formaldehyde novolac is 0.612 cal./kg.

PHENOLIC RESINS FOR PAPER-BASE PLASTICS. H. Kline. Paper Trade J. *119*, 30–2 (Sept. 28, 1944). The phenols, cresols and xylenols are the primary base materials generally used with aldehydes in the production of resins for paper-base plastics. However, the selection of materials is not limited to the above as there are many possible combinations, the selection of which is dependent on the effects desired. To meet specified requirements, modifications may be made by varying the type of phenolic compound, the catalyst, the ratio of formaldehyde to phenol, and the conditions of reaction. Use of phenolic resins in the beater is considered.

SUPERPOLYAMIDES. W. Gaade. Chem. Weekblad *40*, 199–201 (1943); Chem. Abstracts *38*, 5324 (Oct. 10, 1944). The properties and uses of the soluble, low-viscosity superpolyamides made in Germany are discussed. These products are noted for their hardness and elasticity.

MANUFACTURE OF PHENOPLASTICS FROM BROWN-COAL TAR CRESOLS. Z. Csuros and I. Petri. Magyar Chem. Folyoirat *49*, 11–26 (1943); Chem. Abstracts *38*, 6005 (Nov. 10, 1944). Cresols extracted from Hungarian brown-coal tar can be used to make satisfactory molding powders and laminating and impregnating varnishes:

the purified cresol contains 40-50 percent *m*-cresol. In the investigation, the *m*-cresol content was varied from 20 to 75 percent and phenol was also added. With 35 percent *m*-cresol, the chemical and physical properties of the plastics were good except for an insufficiency of hardness. The hardness is improved by using a mixture containing 60 percent *m*-cresol or 30 percent *m*-cresol and 20 percent phenol.

Molding and fabricating

STRIPPING UREA. W. H. MacHale. Modern Packaging *17*, 114–15, 146 (July 1944). Stripping urea resin meets the following five requirements for a closure material: 1) extra flexibility for easy stripping — flexural strength 13 percent higher than regular urea-formaldehyde materials; 2) fast cure for high-production rates; 3) improved torque strength—from 25 to 90 percent stronger than regular urea-formaldehyde compounds, depending on the test methods used; 4) low shrinkage — on the low side of regular urea-formaldehyde materials; 5) good moldability and resistance to surface attack. The stripping grade of urea resin differs from standard urea resin materials in that it has sufficient elasticity at the moment the mold is opened to permit its being instantly stripped, instead of unscrewed, from the threaded portion of the cap mold. In spite of this flexibility, finished moldings have the same permanent hardness of standard thermosetting compounds. On the well-rounded threads used on closures, stripping urea resin can be successfully stripped in sizes of 15 mm. and over. Smaller caps have so great a thread depth in proportion to their diameter that the danger of splitting must be considered. Some molders use wax to aid in stripping phenolic materials, but such an added lubricant is not necessary when running the stripping urea compound. In fact, a lubricant is deleterious, since it causes staining and shearing of threads. Stripping urea resin is available in the same range of colors as standard urea resin formulations, and it may be used in standard flat-bed or automatic stripping-type presses.

Applications

LAMINATION — THEORY AND COMPOSITION. C. A. Southwick, Jr. Modern Packaging *17*, 105–8, 146 (July 1944). The various sheet and adhesive materials used in the production of laminated packaging materials are discussed. The types of laminates and their applications are described.

MELAMINE LAMINATES. R. H. Malamphy. Paper Trade J. *119*, 36–8 (Sept. 28, 1944). The uses to which melamine resins are applied and a general summary of the characteristics imparted to the various products are given. The manufacture of laminates requires special characteristics for the necessary components and they must be properly adjusted to meet the requirements of the conversion processes. Melamine resins are well adapted for white and light pastels as well as sheets of other colors. They also find use in translucent sheets. Among their properties are high resistance to abrasion, to the action of solvents and to heat. In the laminating field they have found use with other fillers such as glass fiber, asbestos, textile fabric and plywood. The melamine resins are also used in the manfacture of high wet strength papers.

PACKAGING FOR POSTWAR EXPORT. Iron Age *154*, 52–8 (Sept. 21, 1944). Metal objects for export shipment should be cleaned to remove dirt and the commonest cause of corrosion, fingerprints. Washing with methanol is recommended. The parts may be packaged by dipping in ethyl cellulose strip coatings, by coating with oils, greases or waxes, and by wrapping with various plastic films.

METALLIC COATINGS ON PLASTICS. H. Narcus. British Plastics *16*, 433-5 (Oct. 1944). Plastics are metal-plated: 1) to produce a substitute for metals, 2) to produce an article which has the inherent properties of plastics with the desirable properties of metals, 3) to utilize scrap plastics, 4) to eliminate the undesirable properties of plastics, and 5) to increase the corrosion resistance of metal-plated articles by eliminating the electrolytic action between the metal-plating and the base material. Plastics may be plated: 1) by applying varnishes pigmented with metallic materials, 2) by metal spraying, 3) by cathode sputtering, 4) by metal evaporation, and 5) by chemical reduction. The chemical reduction method is probably the best. Directions are given for preparing and plating the various types of plastics by chemical reduction. This method may be used to apply silver, gold, copper, lead and nickel. Metal-plated plastics are used for gas and liquid proofing containers, electrical fuzes, contacts, condensers, industrial cams, instruments, machine parts, reflectors, rollers, mirrors, molds for electroforming and electrotyping, novelty jewelry, radio parts such as loop antennae, cabinets, coils, dials, grilles and knobs, and aircraft parts such as dashboard parts and escutcheon plates.

PRESENT AND FUTURE APPLICATIONS OF LAMINATED DENSIFIED WOOD. A. E. L. Jervis. British Plastics *16*, 478–84 (Nov. 1944). The applications of laminated densified wood are reviewed. Present uses include fuze grips, railway fishplates, tooling, work table tops, shelving, machinery parts, boxes, aircraft parts and structural parts for buildings.

CORNER CUBES. A NEW OPTICAL APPLICATION FOR PLASTICS. British Plastics *16*, 501–2, 510 (Nov. 1944). Optical corner cubes made of methyl methacrylate resin for military pocket torches are described. The cubes or prisms were molded of plastic because facilities were not available to produce them of glass in time for the European invasion when they were used.

Coatings

ADHESION OF INDUSTRIAL FINISHES ON NONFERROUS METALS. M. Hess. Paint Manuf. *14*, 264, 266 (1944); Paint Tech. *9*, No. 98, 27-9 (Feb. 1944). Adhesion of a coating material to a metal surface is determined by: 1) the physical condition of the metal surface, 2) the high polarity effects of carboxyl groups, 3) wetting properties of the coating, 4) chemical reaction between the ingredients of the coating and the base, and 5) the reaction products. The adhesive strength is measured by: 1) a bending test, 2) a scratch test, and 3) a cutting test.

ALKYD RESIN FINISHES. G. Leffingwell and M. A. Lesser. Metal Finishing *42*, 718–21 (Nov. 1944). The chemistry, history, properties and uses of alkyd resin finishes are reviewed. Thirty-nine references are given.

THE SELECTION OF THE PROPER COATING. E. Karsten. Metallwaren-Ind. Galvano Tech. *41*, 147–50 (1943); Chem. Abstracts *38*, 5417 (Oct. 10, 1944). Coatings resistant to water are made from polyvinyl chloride, chlorinated rubber, benzylcellulose and bitumens. Coatings resistant to chemicals are made from chlorinated rubber and polyvinyl chloride. The best gasoline resistance is obtained with baked urea resin coatings. The requirements for coating materials are discussed.

COATINGS FOR CABLE CONDUITS. G. Deubner. Teer u. Bitumen *40*, 243 (1942); Chem. Abstracts *38*, 5023 (Sept. 20, 1944). The specifications of the German postal system for asphalt or coal tar base coatings used on the interior surfaces of concrete cable conduits are described.

SCHEME FOR THE CLASSIFICATION OF SYNTHETIC RESINS FOR LACQUERS. C. P. A. Kappelmeier, D. Cannegieter, F. J. Hermann and J. Rinse. Verfkroniek *16*, 89 (1943); Chem. Abstracts *38*, 6115-16 (Nov. 10, 1944). A classification scheme is presented for the resins used to formulate organic protective coatings.

U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each.

PLASTIC RIBBON. V. Spencer (to Armstrong Cork Co.). U.S. 2,364,248, Dec. 5. A method for producing continuous ribbons of plastic material on a calender roll.

POLYMER. W. R. Peterson (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,364,387, Dec. 5. A solid, synthetic, linear polyamide is depolymerized in the presence of water and polymerized by removing the water and reacting with different polyamide- or polyester-forming units.

MOLDING. F. G. Purinton and W. A. Zweibel (to Patent Button Co.). U.S. 2,364,388, Dec. 5. A method for molding decorative plastic articles comprising an object composed of two different colors.

SCREEN. H. W. Thomas. U.S. 2,364,404, Dec. 5. A plain-weave open-mesh window screen consisting of intersecting warp and weft monofils of a synthetic linear polyamide.

PLASTIC. D. Whittaker (to Imperial Chemical Industries, Ltd.). U.S. 2,364,410, Dec. 5. Chlorinated polythene containing from 0.1 to 5.0 percent of sodium lactate.

FILMS. H. D. Foster and A. W. Larchar (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,364,435, Dec. 5. An apparatus for extruding films of polymeric materials.

RUBBER HALIDES. J. W. Raynolds and M. R. Radcliffe (to Raolin Corp.). U.S. 2,364,589, Dec. 5. Chemically resistant coatings are composed of chlorinated rubber and an acrylic or methacrylic acid ester polymer.

RESINS. M. T. Harvey (to Harvel Research Corp.). U.S. 2,364,712, Dec. 12. A phenol, such as phenol, naphthol, anthranol, etc., and an unsaturated alkyl ether of a phenol are condensed in the presence of a katenoid condensing agent.

HEEL. T. C. Morris (to B. B. Chemical Co.). U.S. 2,364,744, Dec. 12. A molded heel consisting of a cured resin and a fibrous material coated with a composition of a cured resin, cellulose particles and pigment.

MOLD. R. E. Moule (to General Motors Corp.). U.S. 2,364,745, Dec. 12. Mold equipment for the production of plastic objects having smooth surfaces.

LAMINATE. E. W. Otto (to Western Lithograph Co.). U.S. 2,364,870, Dec. 12. A method for producing a laminated plastic article such as an identification badge frame having a recess or slot for receiving an insert.

RESIN. F. A. Hessel and J. B. Rust (to Ellis-Foster Co.). U.S. 2,364,900, Dec. 12. A composition comprising a water-soluble formaldehyde-hardenable melamine condensate and a hardener comprising a water-soluble acetone resin consisting of the reaction product of acetone and formaldehyde in presence of borax.

GIRDLE. A. N. Spanel. U.S. 2,365,016, Dec. 12. A girdle consisting of pliable, elastic, thermoplastic film material.

INSULATION. H. J. Stewart (to General Electric Co.). U.S. 2,365,019, Dec. 12. An electrical conductor is insulated with a wall of glass fibers coated and impregnated with a thermoset soya bean oil, a glass braid over the wall, and a baked, heat-stable synthetic resin coating and impregnant on glass braid.

DISPLAY SIGN. F. Wirtz (to Burdick-Baron Co.). U.S. 2,365,034, Dec. 12. An advertising sign comprising an open mesh screen, an opaque plastic base-foundation completely enclosing and filling the screen.

PHENOLIC RESINS. W. N. Traylor (to Hercules Powder Co., Inc.). U.S. 2,365,121, Dec. 12. A soluble, fusible phenol-aldehyde resin is refined by treating in solution with nascent hydrogen.

ALKYD RESINS. W. N. Traylor (to Hercules Powder Co., Inc.). U.S. 2,365,122, Dec. 12. A modified alkyd resin is refined by treating in solution with nascent hydrogen.

COUMARONE-INDENE RESIN. (to Hercules Powder Co., Inc.). U.S. 2,365,123, Dec. 12. A coumarone-indene resin is refined by treating with nascent hydrogen.

CELLULOSE ESTERS. B. S. Farquhar and F. Schulze (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,365,258, Dec. 19. Cellulose acetate is stabilized by washing freshly acetylated cellulose to remove acids and treating with steam under pressure.

SHEET. J. Bailey (to Plax Corp.). U.S. 2,365,326, Dec. 19 Apparatus for forming sheets or ribbons of plastic material.

MOLDING. W. W. Carter (to Brayton Morton). U.S. 2,365,331, Dec. 19. An article is molded from a loosely felted and porous compressible mass of fibers containing a heat-hardenable resin.

POLYVINYL IMIDES. W. E. Hanford and H. B. Stevenson (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,365,340, Dec. 19. A polyvinyl imide is cleaved by a hydrolytic agent at a temperature of 100 to 200°C.

EXTRUSION MOLDING. J. Bailey (to Plax Corp.). U.S. 2,365,374-5, Dec. 19. Methods for preparing shaped articles by extrusion molding.

HALOGENATED POLYMERS. H. Fikentscher (to Alien Property Custodian). U.S. 2,365,400, Dec. 19. Halogen-containing polymers such as chlorinated rubber, polyvinyl chloride, etc., are heat stabilized by adding sodium carbonate and a diaryl thiourea.

PLASTIFYING AGENT. E. Gartner (to Alien Property Custodian). U.S. 2,365,405, Dec. 19. Synthetic rubber is made plastic by the addition of 1 to 3 percent of an anhydroformaldehyde-arylamine.

POLYMERS. C. H. Alexander and F. K. Schoenfeld (to B. F. Goodrich Co.). U.S. 2,365,506, Dec. 19. Vinyl chloride is polymerized in an aqueous emulsion with a peroxide catalyst in the presence of a lead salt of a saturated fatty acid.

CORK COMPOSITION. P. R. Austin (to E. I. du Pont de Nemours and Co., Inc.). U.S. 2,365,508, Dec. 19. A composition of finely-divided cork bonded with a fusible synthetic linear polyamide consisting of the reaction product of a diisocyanate with a low molecular weight polyesteramide.

DOMES. E. L. Helwig (to Rohm and Haas Co.). U.S. 2,365,637, Dec. 19. A process for shaping rigid domes from synthetic, organic, thermoplastic sheet material by means of vacuum technique.

CELLULOSE ESTERS. R. L. Stern (to Hercules Powder Co., Inc.). U.S. 2,365,652, Dec. 19. A molding composition consisting of a cellulose mixed ester colloided with a plasticizer and containing an acid having a dissociation constant in the range 0.04 to 0.0001.

BOOKS AND BOOKLETS

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent post-paid at the publishers' advertised prices.

Industrial Radiology and Related Phenomena

by H. M. Muncheryan

Published by Aircraft X-ray Laboratories, Huntingdon Park, Cal. (1943)

Price $7.50 **539 pages, 179 illustrations**

The important new technique for nondestructive testing of parts with x-rays and gamma rays is fully described by this author. He has prepared specific illustrations of radiographs and photomicrographs of both sound and defective metallic materials to assist the beginner in recognizing imperfections. Also reviewed are the principles of magnetic inspection whereby discontinuities in structures are detected by the pattern taken by magnetic powders on magnetized metal surfaces. Other topics considered are the atomic phenomena pertinent to radiology and the fundamentals of electricity and x-ray radiations. G.M.K.

Woodflour

by W. S. Dahl

Published by the author, 30 Stanley Road, Mortlake, London, S.W.14, England (1944)

This 44-page booklet describing the manufacture of woodflour and its numerous uses is based on the author's pioneering experience in the industry, dating back to the early 1900's. The applications discussed, in addition to that as a filler for plastics, include: linoleum manufacture, composition flooring, tinplate cleaning and polishing, plastic wood and explosives. Some information is given on specifications for woodflour for use in molding powders. In the next edition the author should consider adding wherever possible formulas for the compositions employed for the various purposes outlined in his interesting survey. G.M.K.

The Chemistry of Cellulose

by Emil Heuser

Published by John Wiley and Sons, Inc., 440 Fourth Ave., New York, 1944

Price $7.50 **660 pages**

The fundamental chemistry and morphology of cellulose are reviewed and interpreted by an outstanding authority in this valuable contribution to the literature on this subject. The reactions of cellulose with water, alkalies, salt solutions, acids and oxygen, its decomposition by heat and biological processes, and the properties of its esters, ethers and xanthates are covered in individual chapters. The chain and fibrous structures of cellulose and current methods for the determination of the molecular weight of high polymeric substances of this type are among other topics considered. Comprehensive subject and author indexes and extensive illustrations and diagrams make this book very useful both for reference and textbook purposes. G.M.K.

Modern Synthetic Rubbers, 2nd Edition

by Harry Barron

Published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York, 1944

Price $6.50 **355 Pages**

The background of synthetic rubber development is reviewed by the author, who divides his review into three parts dealing, respectively, with economic, chemical and technological phases. Raw materials and polymerization processes are given special attention. The synthetic elastic materials considered include not only the butadiene and polysulfide derivatives, but also polyethylene, polyisobutylene, the vinyl resins and ethylcellulose. A chapter on comparative properties of these materials is particularly noteworthy. Comprehensive references are given at the conclusion of each chapter.

The author has been a persistent advocate of a synthetic rubber program for Great Britain. He makes a special point of the fact that a large-scale synthetic rubber industry paves the way for a healthy expanding thermoplastics industry through their common raw material requirements. G.M.K.

★ A 36-PAGE BOOKLET RECEIVED from Hercules Powder Co., Inc., Wilmington, Del., lists Hercules chemicals and industrial explosives and the many industries which Hercules products serve. The products are indexed according to various industries in which they are used and then according to chemical families. Cellulosic chemicals, rosins and modifications, rosin esters and synthetic esters, terpene solvents and chemicals, explosives, and special products are discussed and postwar applications are indicated.

★ THE HISTORY OF GLUE, DEvelopment of modern, permanent-bonding, waterproof resin types, methods of using them in fabricating and a wide range of present-day applications are described and illustrated in a colorful 28-page booklet published by Plaskon Div., Libbey-Owens-Ford Glass Co., Toledo, Ohio.

★ A 16-PAGE BROCHURE FROM Kimberly Clark Corp., Neenah, Wis., outlines briefly the history of Kimpreg, its many uses and advantages. Among these advantages are its durability, moisture resistance, acid-, alkali- and abrasion-resistance. Three types of finishes are offered — glossy, flat and sandy. Currently the material is available only in olive drab but postwar developments promise a variety of bright colors.

★ PROPERTIES AND APPLICAtions of Marbon S and S-1 resins, when blended with GR-S, are listed in a brochure released by Marbon Corp., Gary, Ind. These new synthetic resins are claimed to have excellent electrical and mechanical properties and act as both heat plasticizers and organic fillers. Availability, a variety of applications, fabrication and specifications of the resins are listed.

★ RESISTOFLEX CORP., BELLEville, N. J., announces an illustrated catalog of industrial products made from compar — the specially compounded solvent-proof vinyl resin. Properties, characteristics and specifications of each product are contained in twelve illustrated sections: low-pressure lube and grease hose; low- and medium-pressure hydraulic hose; super-chemical hose; refrigerant hose; refrigerant charging hose; transparent "V" tubing; type identification of end fittings; industrial gloves; work aprons; mechanical molded goods; coatings; adhesives and paints.

★ POSTWAR BUILDING STUDIES No. 3 is the report of a committee convened by the British Plastics Federation, published for the Ministry of Works by His Majesty's Stationery Office, London, England. Seven groups of plastics were investigated as to their practicabil-

ity in building—molded plastics, laminated plastics, transparent and opaque sheeting, resinous materials, plastics, cements and adhesives, extruded plastics, resin bonded sheets and miscellaneous, including expanded plastics. The report covers materials, processes of manufacture and properties; application of plastics to building uses; design and standardization. Copies may be obtained at H. M. Stationery Office or through any bookseller for one shilling.

★ THE LATEST BOOKLET FROM Celanese Plastics Corp., New York, N. Y., covers the many available forms of Celanese plastics. These materials give product designers three extra designing aids—color, transparency and lightness—plus toughness and impact strength. A table of types and forms and application photographs aid the designer in selecting materials best suited to his need.

★ "PLASTICS—A HANDBOOK for Retailers," published by the Bulletin of the National Retail Dry Goods Ass'n., New York, N. Y., is designed to serve as a buying and merchandising guide for department and specialty stores. Prepared in cooperation with the Society of the Plastics Industry, Inc., the booklet is written in terms easily understood by the layman. Characteristics and typical applications of each type of plastic in the consumer merchandise field are described. A "capsule encyclopedia of plastics" and a chart defining every trade-named plastic in terms of its basic type and characteristics are additional interesting features of the handbook.

★ "ADDED HONORS FOR KING Cotton" summarizes recent and current progress in the industrial uses of cotton linters and by-products. The book, received from the Rayco Linter Cotton Div., Railway Supply and Mfg. Co., Cincinnati, Ohio, points out the increasing use of cotton fibers in the paper, plastics, lacquers, packaging and other industries as a result of continued product and marketing research, and discusses the company's pioneering activities along these lines.

★ A TEMPERATURE CONTROL system now available for the first time is described in a new catalog, No. N-00A(2), by Leeds & Northrup Co., Philadelphia, Pa. The system is designed especially to bring to electrically-heated units a regulation of heat-input as dependable as their position-adjustion type of micromax electric control, long in use with fuel-fired furnaces.

Schematic illustrations show how control action is obtained by regulating the proportion of time during which current is "full on" and "full off." The control system in use in representative plants is shown in installation photographs.

★ NORTH AMERICAN PHILIPS Co., Inc., New York, N. Y., has issued a 12-page booklet describing x-ray diffraction techniques and applications. Diagrams, typical diffraction films and several tabulations show how Norelco x-ray diffraction equipment is used for identification, research and production. Outstanding features of the equipment are explained and special pages are devoted to powder, back-reflection-focusing and low-angle scatter cameras.

★ AN ENLARGED EDITION OF the Thermocouple Data Book and Catalog has been received from Wheelco Instruments Co., Chicago, Ill. Designated S2-5, the bulletin lists the products and their prices, recommendations for thermocouple users, selection data on the units themselves, lead wire, protecting tubes, heads and insulators. Numerous tables help to clarify the information given in the text.

★ A TWO-COLOR FOLDER ENtitled "Amercoat No. 33 Plastic Coating," describes the properties, uses and benefits of this general-purpose, cold-applied, protective coating. Technical facts are presented ranging from application, coverage and colors, to degrees of weathering, moisture absorption and transfer, and resistance to chemical fumes, splash and over-flow of acids, alkalis, salts, oils, water, and so forth.

★ BULLETIN 441T, RECEIVED from United Electric Controls Co., Boston, Mass., describes their Type K thermostat, a precision-built temperature control. Photographs, blueprint and a chart of model characteristics are included in the bulletin.

★ VICKERS VARIABLE-DELIVERY piston-type pumps are the subject of a recent bulletin issued by Vickers Inc., Detroit, Mich. Features of construction, operation, efficiency, types of controls, instruction on installation and operating are covered in sections of the brochure. Blueprints and charts clarify the various types of controls.

★ BULLETIN YM-800, ISSUED BY Youngstown Miller Co., Sandusky, Ohio, describes the operation and exclusive features of their plastic coaters. Although designed to melt correctly the ethyl cellulose compounds and other plastic coatings used for protecting parts to be shipped, the same equipment is used also for melting low-temperature plastics for permanent coatings.

★ AN 8-PAGE ILLUSTRATED catalog, P-1, has been received from Punch-Lok Co., Chicago, Ill., containing complete technical data on their entire line of clamps and fittings to aid in the application and proper use of the locking tool for connecting male and female fittings, nipples, menders or pipe to hose.

★ CHAS. E. FRANCIS CO., Rushville, Ind., has compiled a pamphlet—Bulletin No. L-2—on their line of hydraulic presses for use in all types of laminated work.

★ LESTER-PHOENIX, INC., Cleveland, Ohio, have issued a concise catalog of their line of high-pressure die-casting machines. Units HHP-3, HHP-3X-PF, HHP-1, HHP-1 CC, HHP-2 and HHP-2 CC are included with a photograph, description and list of specifications for each machine.

★ THE THREE REASONS claimed by Champion Diamond Co., New York, N. Y., for the longer life of their diamonds are skillful selection, setting and application. This data together with a listing of their products, is given in a current 4-page leaflet just received.

★ THE NEW CATALOG OF South Bend Lathe Works, South Bend, Ind., No. 100-D, featuring 21 full-color lathe illustrations, describes all the company's engine lathes, toolroom lathes and precision turret lathes in detail. Specifications are listed for each lathe illustrated. The balance of the catalog is devoted to construction features of the lathe, lathe tools and attachments for special classes of work.

★ CORRECT DRILL POINTING IS the title of a pamphlet by Chicago-Latrobe Twist Drill Works, Chicago, Ill., designed to correct procedure for pointing twist drills used on all types of materials. Diagrams showing drill points recommended for various materials and a table of cutting speeds are included.

★ OWENS-CORNING FIBERGLAS Corp., Toledo, Ohio, has issued a booklet on the use of Fiberglas in industry. Because of its fine fibrous form, this material gains characteristics which make it an excellent insulating material. Temperature, moisture, abrasion and insulation resistance; tensile, dielectric and impact strength; thermal conductivity and impregnating characteristics mark this material as an important part of electrical products and equipment. Available in yarn, cordage, sleeving, cloth, tape and magnet wire, among many other forms, Fiberglas is finding use in such industries as mining, transportation, automotive, paper, steel and chemistry.

A CINCH FOR DoALL Zephyr

SMOOTH, RAPID CUTTING of PLASTICS • PLYWOODS LAMINATES • WOOD

Especially designed to cut the new, tough materials, the Zephyr is speeding through work in war plants. And, these light-weight materials are here to stay—will be used for thousands of civilian products.

The Zephyr cuts them as easily as the Black Widow zooms through flak-infected skies.

Right now and in the future, the DoALL Zephyr can take away your cutting worries.

•

The Inside Story of Zephyr in pictures sent on request

Saran up to 3" thick cut at the rate of 15 to 30 sq. in. per min.

Saran Tubing ½" to 4" diam. at rate of .03 to .12 minutes per cut

Zephyr slices through Butyl like a knife going through cheese

DoALL

INDUSTRY'S NEW SET OF TOOLS

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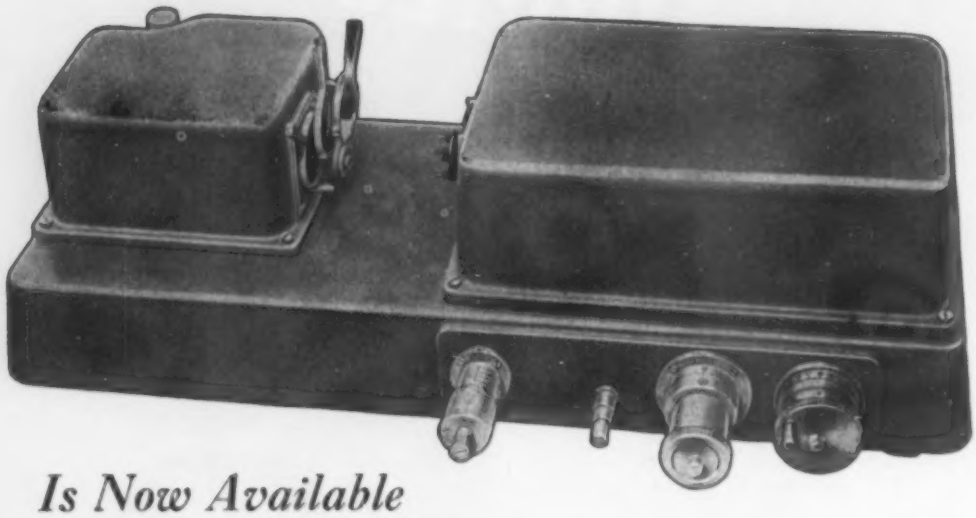
Sales & Service Offices in principal cities. Boston, Chicago, Cincinnati, Detroit, Grand Rapids, Hartford, Houston, Indianapolis, Los Angeles, Milwaukee, Minneapolis, New York, Orlando, Philadelphia, Pittsburgh, Providence, Rochester, Rockford, St. Louis, San Francisco, Seattle, Syracuse, Toledo, Tulsa

THIS ALL-PURPOSE INFRARED SPECTROMETER

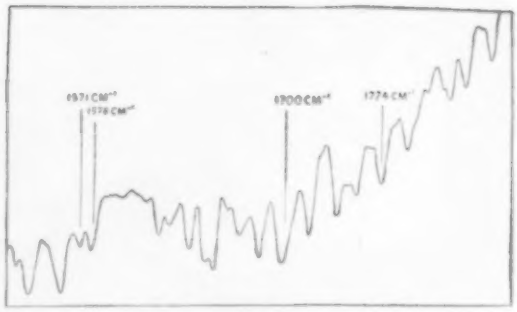


*Is Now Available with Recorder and Amplifier**

The new Perkin-Elmer recording Infrared Spectrometer provides a method for the direct identification of characteristic functional groups in complex molecules, replacing a multiplicity of specific chemical tests. Unique "fingerprints" of molecules obtained by this method — their complete infrared spectra — give positive compound identification. The instrument's photometric accuracy makes possible quantitative analyses of many complex mixtures and direct comparisons with known calibration standards.

*The recorder and amplifier can be obtained separately or mounted with the spectrometer in a single cabinet that can be set up in any laboratory where water and power are available. Pen and ink records of spectra are obtained directly on the eleven inch width strip chart. They are illustrated in the sample spectrum of the 6 micron water vapor absorption band at the right, made with these accessories and a rock salt prism. The charts are accurate enough for precise intensity and wave length measurements and also serve as permanent records that may be remeasured at any time to determine additional information. The amplifier used in place of the galvanometer is available only to those working directly or indirectly on Government contracts.

At your request, we will gladly send you further information about the advantages of infrared spectroscopy and the Perkin-Elmer recording Infrared Spectrometer.



SPECIAL FEATURES

- Equipped for gas, liquid, or solid samples; vapor path up to 50 cm. available for low concentration work.
- Simple prism mounting for easy interchange of prisms.
- Grouped controls.
- Compact (12" x 31" x 9"), sturdy design; airtight covers to permit reduction of atmospheric interferences.
- Optical speed f:4.5; 60° prism, face 60 x 75 mm.; off-axis parabolic collimation.
- Precise optical parts for high resolution.
- Multispeed wave length drive.
- Accurate, adjustable correction of wave length scale for temperature changes.

THE PERKIN-ELMER CORPORATION

GLENBROOK · CONN ·

Gets the most out of LOW-PRESSURE POWER

. . . does everything but read your mind

HERE is a special-purpose Elmes press for deep molds with thin sections. It functions entirely upon low-pressure power except when resistance encountered cuts in the high-pressure circuit automatically.

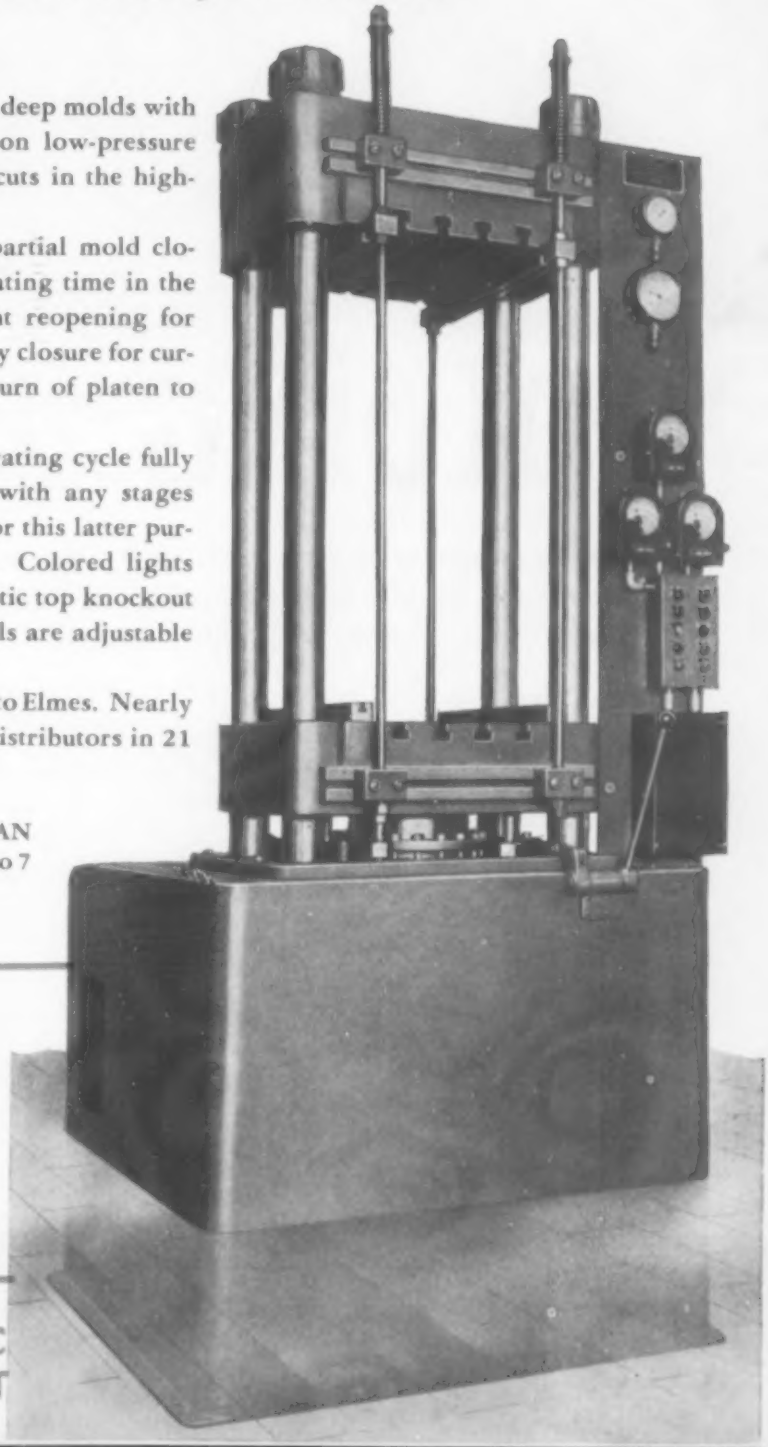
Normal cycle of operation includes: (1) partial mold closure, with a pause which allows desired heating time in the mold; (2) full closure, followed by a slight reopening for breathing; (3) breathing interval, followed by closure for curing; (4) curing interval, reopening, and return of platen to starting position.

Pressing the "run" button makes the operating cycle fully automatic, either in complete sequence or with any stages eliminated. Selector switches are provided for this latter purpose, and for "jogging" when setting dies. Colored lights flash on to indicate occurring stages. Automatic top knockout bars, molding pressure, and all stage intervals are adjustable to suit requirements.

You, too, can put your pressing problems up to Elmes. Nearly a century of progressive specialization, and distributors in 21 cities, are at your service.

ELMES ENGINEERING WORKS *of* AMERICAN STEEL FOUNDRIES, 225 N. Morgan St., Chicago 7

Also Manufactured in Canada



This self-contained, 15 h.p., 225-ton plastics press is typical of modern Elmes designs for compression and transfer molding. Elmes simplified controls are fast, accurate, instantly responsive. Elmes engineering and sturdy construction are your assurance of performance at its best. Send for literature.

MODEL NO. 6622

ELMES HYDRAULIC EQUIPMENT

METAL-WORKING PRESSES · PLASTIC-MOLDING PRESSES · EXTRUSION PRESSES · PUMPS · ACCUMULATORS · VALVES · ACCESSORIES

MOLDING *with the ACCENT on FACILITIES and CONTROL—*

It isn't merely a question of perfect dies which assure a perfect product. The facilities which are available, and the positive control essential to maintain standards of *uniformity* may be implied when you buy custom molding. But they are positive assets, *definitely present* in the making of every CELLUPLASTIC product. They are guarantees of satisfaction for every inch of continuous lengths of

The Celluplastic Engineering and Technical Staff is at your service. Inquiries are invited!

EXTRUSION MOLDED

RODS—TUBES—TAPE—SHEETS and SPECIAL SHAPES

INJECTION MOLDING

OF INTRICATE AS WELL AS SIMPLE PARTS

in various standard thermoplastics are also produced under skilled supervision, raw material control and critical inspection. *Your* choice of color in opaque or transparent form.

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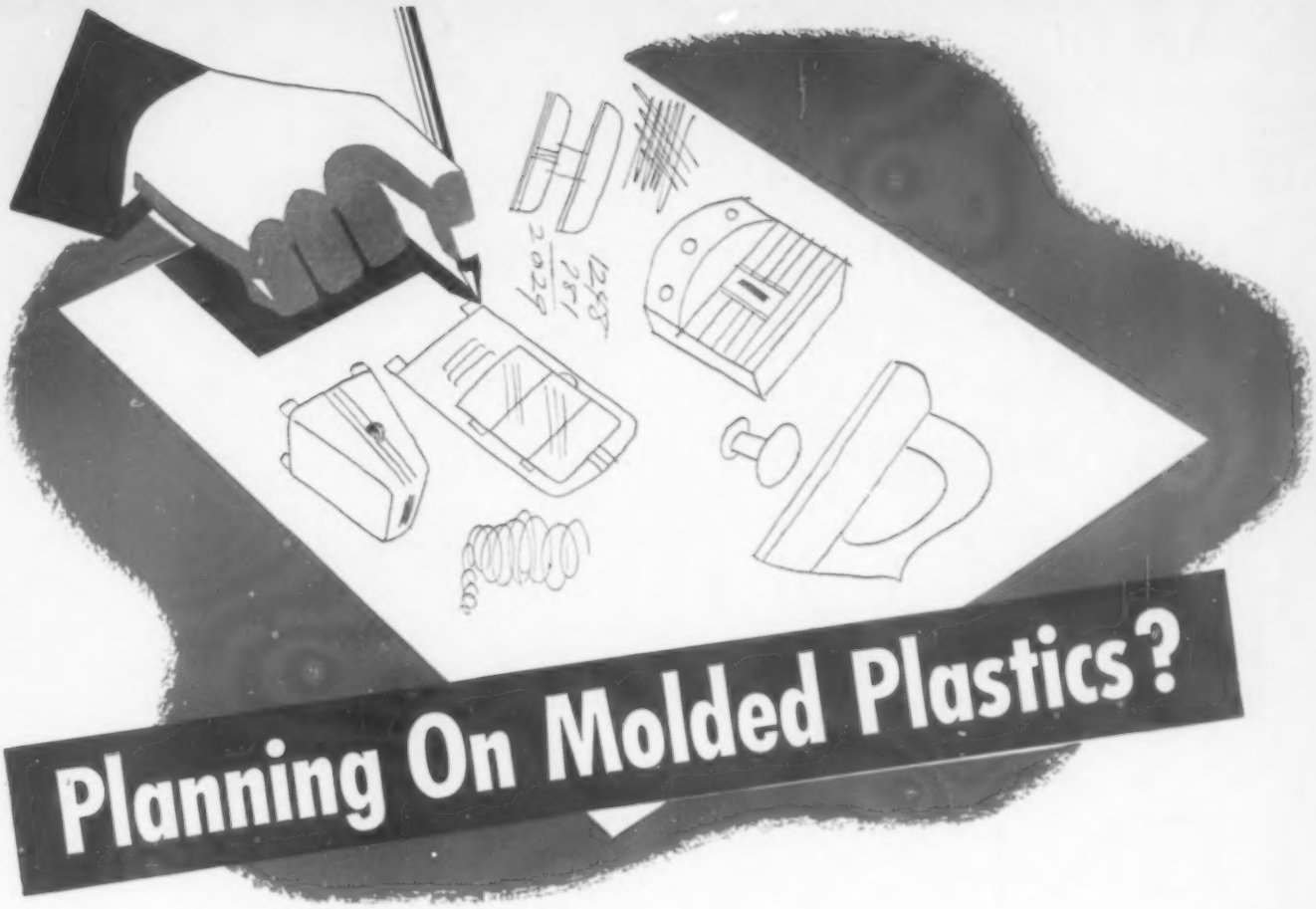
44 AVENUE L NEWARK, N. J.

WEST COAST REPRESENTATIVES: CONTAINER SERVICE CO., 1266 North Western Avenue, Los Angeles 27, Cal.



Planning On Molded Plastics?

Many postwar ideas now growing into more finished form in engineering and drafting rooms will call for molded plastic parts.

For these, General Industries offers the services of its molded plastics division.

Please get us right. We make no pretense at *designing* your molded plastic parts. You know that job better than we ever hope to.

But, we can tell you whether it's a practical molded plastic job. We can help you select the right plastic compounds—and in many cases can suggest minor changes or refinements resulting in better parts, delivered faster or more economically.

This "know-how" extends through our mold-making and processing divisions. Small parts or large ones are carefully and skillfully engineered through the intricacies of mold-designing, so that when they leave the molds they are accurate in dimensions and finely finished.

Of course, we have the necessary machines for the molding of large or small work, in any quantities, by compression, transfer or injection processes. And we keep our delivery promises.

So, if you are planning postwar products that include molded plastics, keep in touch with General Industries. Right now, we're working 100% for Uncle Sam, but when the end of that is in sight, we'll be glad to work with you.

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ARMY E NAVY

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has grown

PENACOLITE 1942
and grown

PENACOLITE 1943
and grown

PENACOLITE 1944
and now

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IS THE ACCEPTED STANDARD
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QUALITY and PERFORMANCE
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Questioning Present Production Methods?

Planning Tomorrow's Products?

MONROE METAL PLATED PLASTICS
often prove the answer

They open up a wide range of entirely new possibilities for making products and parts *better—stronger—more attractive in appearance—less expensive!*

Metal plated by Monroe (successful with any plateable metal)—plastic parts have greater tensile strength—*41.3% increase* over original unplated part reports one aircraft manufacturer.

Also, they have substantially greater flexural strength, greater impact resistance, greater dimensional stability due to increased resistance to heat and cold flow.

Control of absorption and corrosion are additional advantages—and they have interesting possibilities for use in the field of electronics.

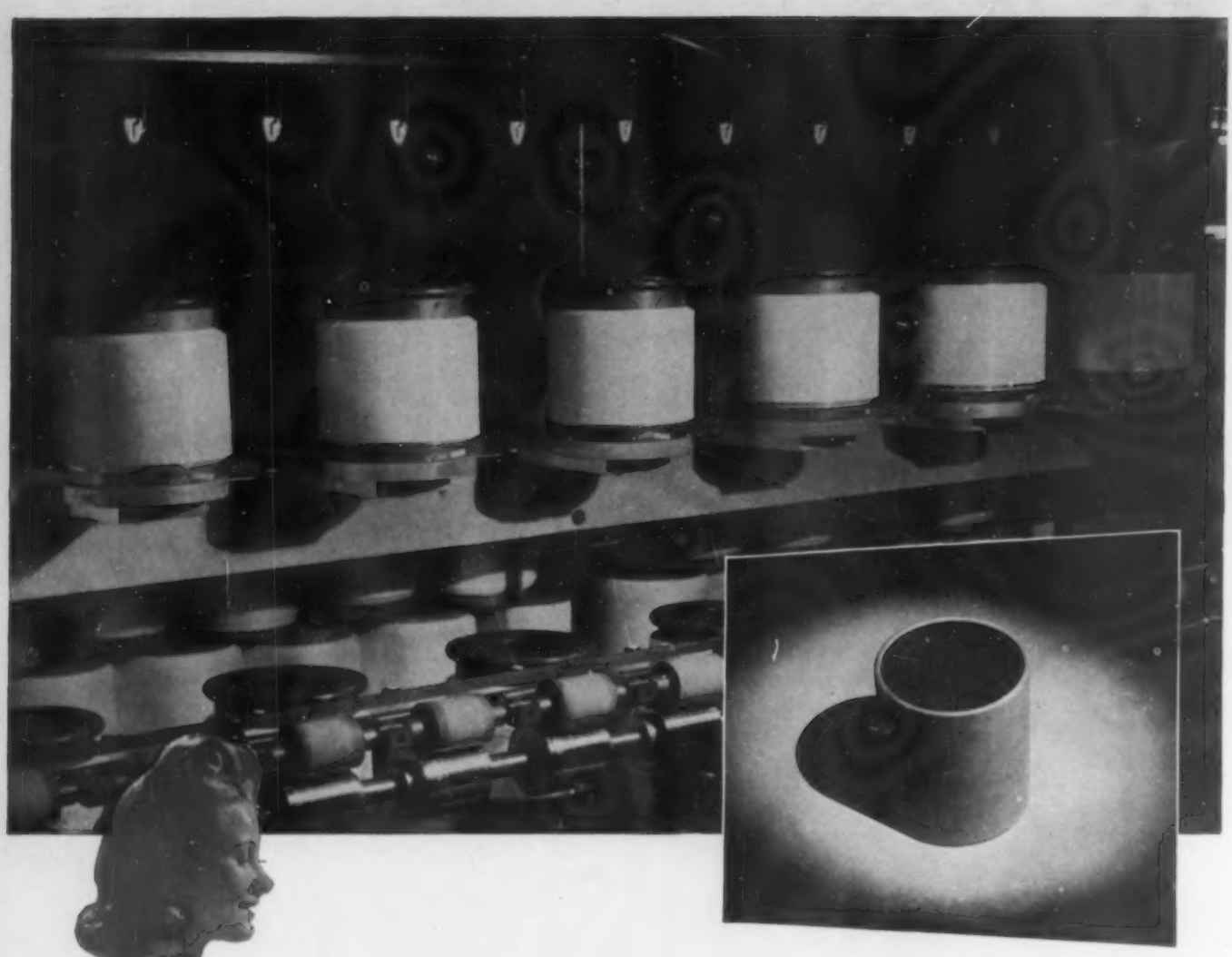
INVESTIGATE! Every facility will be provided your engineers and designers for testing specific applications.

MONROE

MONROE AUTO EQUIPMENT CO... MONROE, MICH.

PLASTICS DIVISION

The Metaplast Process



Phenolite Bobbins

help speed the production of high strength NYLON Yarn

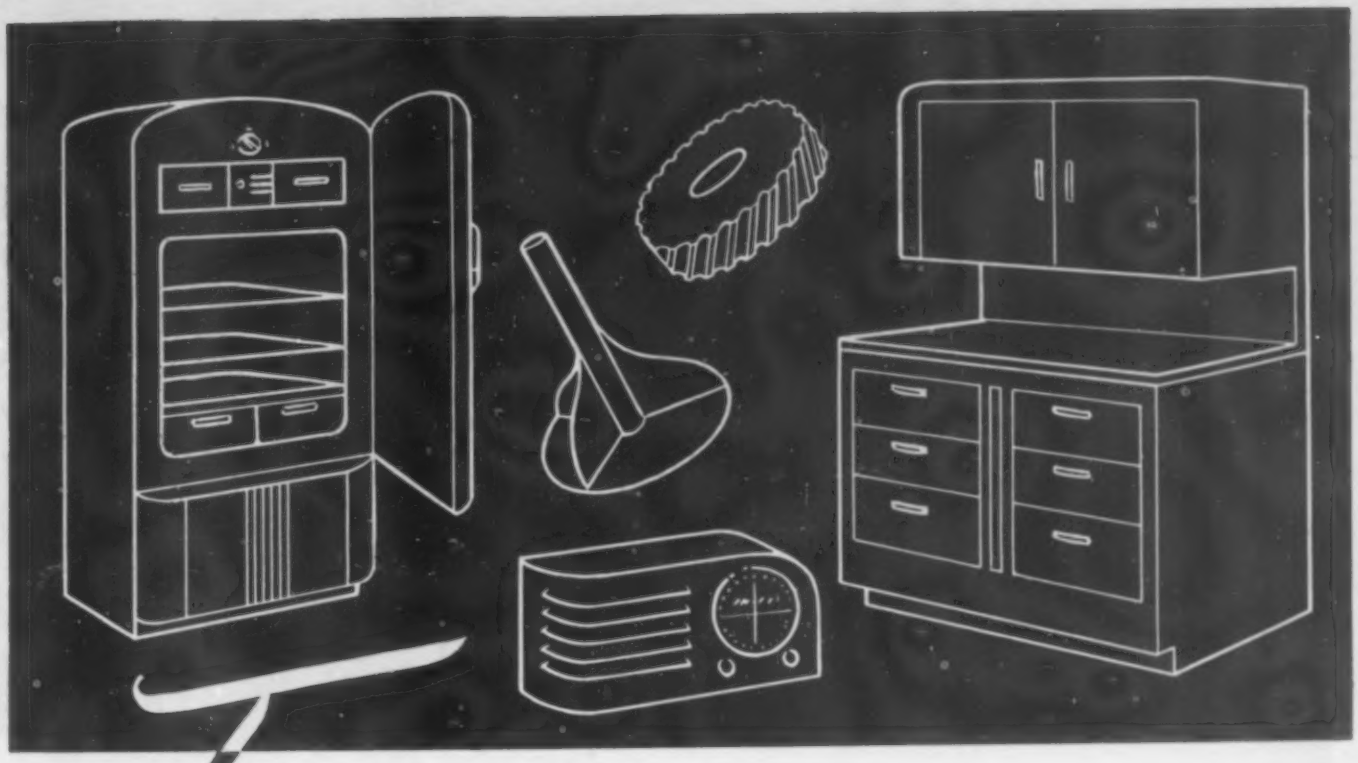
No, not for ladies' hosiery right now, but for Uncle Sam's war needs—such as parachute fabrics and glider tow ropes—Phenolite laminated Bakelite Bobbins play an important role. Their exceptional resistance to deformation at high speeds and stresses—combined with their lightness in weight—contributes to the uniformity of the nylon yarn in the high speed "spinning" and "throwing" operations.

This application of Phenolite is typical, illustrating how the unusual combination of properties of this laminated plastic may be utilized in practically every industry to good advantage.

National Engineers are at your service to assist in the design of your improved products . . . in which Phenolite may have an advantageous application. Wire, phone or write today!

NATIONAL VULCANIZED FIBRE CO.

Wilmington, Delaware *Offices in Principal Cities*



Tomorrow's "LAMINATES"

... are here today with VARCUM LIQUID RESINS

- ✓ WATER RESISTANT
- ✓ FAST CURING
- ✓ ODORLESS
- ✓ USE NO SOLVENTS
- ✓ LIGHT IN WEIGHT
- ✓ MORE ECONOMICAL

In your immediate coating, impregnating or saturating problems—as well as in your plans for future products, Varcum *Liquid* Resins open many avenues to better quality, faster curing and safer production.

The Varcum line includes a wide range of liquid resins formulated to suit various applications. Their general advantages (listed to left) include their use as saturants for scrap fabric to make high impact strength molding compounds for rigid compression moldings.

Your potential uses for liquid resin will receive our prompt attention, with practical suggestions.

Synthetic VARCUM Resins

VARCUM CHEMICAL Corporation

★ NIAGARA FALLS, N. Y ★

"The Only Ticket I Get For High-Speed Driving . . . is the Inspector's OK Tag!"

. . . and he's making faster fastenings every day with AMERICAN PHILLIPS SCREWS

The slowest workers become highly efficient when you equip them with American Phillips Screws and power drivers. They're no longer slowed down by frequent fumbling and dropping, by crooked driving, or by screws with broken heads that must be backed out and replaced.

And the driving process itself is far faster, with American Phillips Screws. For the driving bit and screw align themselves into one straight driving unit . . . can't twist apart . . . don't have to be held in line by main strength. This permits the use of power drivers, multiplies man power, and gives maximum return on screw-driving costs, to small users as well as large.

The American brand of Phillips Recessed Head Screws is made under rigid laboratory check, and a unique system of piece inspection. Delivery service is maintained by high-speed production. And engineering service is at *your* service on any problem.

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Take a Recess from Slotted-Screw Costs and Troubles . . . the Tapered, Engineered Recess of:

AMERICAN PHILLIPS *Screws*

PATENTS MAKE JOBS

Put the Screws on the Japs
BUY BONDS

AUTOMATIC TUNING

CONSTANT POWER OUTPUT

TWO-LOAD SELECTOR

are only a few of the features in the

MODEL DE

AIRTRONICS Preheater

HERE is the electronic preheater that fills a long felt need among molders for a machine of

... greater power output
... maximum operating simplicity

AIRTRONICS Model DE Preheaters fully meet this need — 2½ KW output, and *completely* automatic operation.

A unique feature of this model is the *dual load-selector*. Two starter buttons control the automatic tuning for two different preform charges, so that one operator can handle two presses using different materials or sizes of preforms. In addition, the power output is automatically maintained at any desired load during the entire heating cycle.

The table at the right shows the comparative heating times for popular types of plastic materials, using the AIRTRONICS Models CB and DE —

Material	Weight	Preheating Time		Final Temp.
		Model CB	Model DE	
BM120	16 oz.	90 sec.	45 sec.	240°F
BM926	12 oz.	75 sec.	30 sec.	240°F
DUREZ 55	7 oz.	45 sec.	22 sec.	245°F
DUREZ 2491	7 oz.	45 sec.	23 sec.	240°F
TEXOLITE 1589	14 oz.	85 sec.	43 sec.	240°F
BM120	32 oz.		100 sec.	250°F
BM926	26 oz.		65 sec.	245°F

Send for complete data on AIRTRONICS Preheaters, specifying the model that fits your needs, or submit your preheating problem for our analysis and recommendations—no obligation. **Write Dept. M. P.**

Airtronics MANUFACTURING CO.

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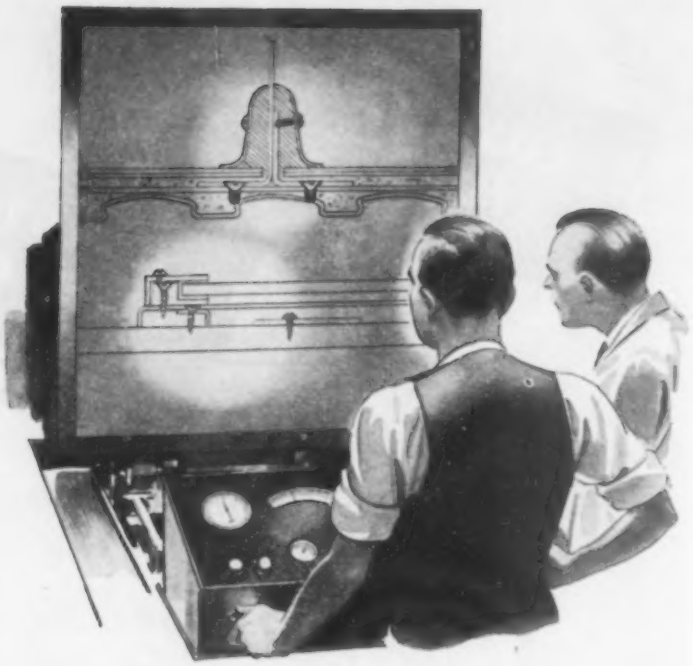
Put your plans for peacetime products through the

Par-Ka-Scope

find the "FASTENING BUGS" *NOW* avoid COSTLY CHANGES *LATER*

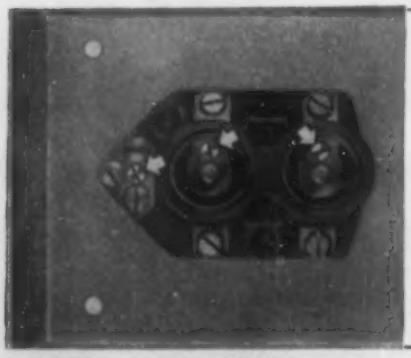


LENS of the "Par-Ka-Scope" is the eagle eye of a Parker-Kalon Assembly Engineer. He can help you focus on the "fastening bugs" that usually hide out until you are all set up for production, then start running up costs.

THE "BUGS" may be needless tapping, slow bolt-and-nut assembly, costly inserts in plastics that slow up molding, riveting in hard-to-reach places. Whatever they are, he'll help you find them now, when a changeover to the short-cut fastening method . . . with P-K Self-tapping Screws . . . requires only a little pencil work.

SAVINGS OF 30% to 50% are the common experience of thousands of manufacturers who have adopted this *short cut method of assembling metals or plastics.*

THE P-K ASSEMBLY ENGINEER'S advice is unbiased. He'll recommend only the best Self-tapping Screw for the job – Parker-Kalon makes *all* types. Tell us when you'd like him to call, or send details of fastening jobs for recommendations.



THIS PRODUCT CARRIED A NEEDLESS 200% EXCESS ASSEMBLY COST . . . WILL YOURS?

By using P-K Type "F" Screws to fasten brass contacts to a Bakelite fuse block, Federal Electric Products Co., Newark, N. J., made *a saving of ⅔ in time and labor* over previous methods—eliminating slow nut and bolt fastening, and tapping and tap expense for machine screws. Made a better product, too—reduced rejects and breakage caused when machine screws were backed out by vibration.

GET THIS GUIDE—IT'S FREE

The P-K "Users' Guide" describes all types of Parker-Kalon Self-tapping Screws, and tells where and how to use them. Arranged so you can find the facts you need quickly. Write for it. Parker-Kalon Corp., 208 Varick St., New York 14, N. Y.

PARKER-KALON
Quality-Controlled
SELF-TAPPING SCREWS

For Every Metal and Plastic Assembly

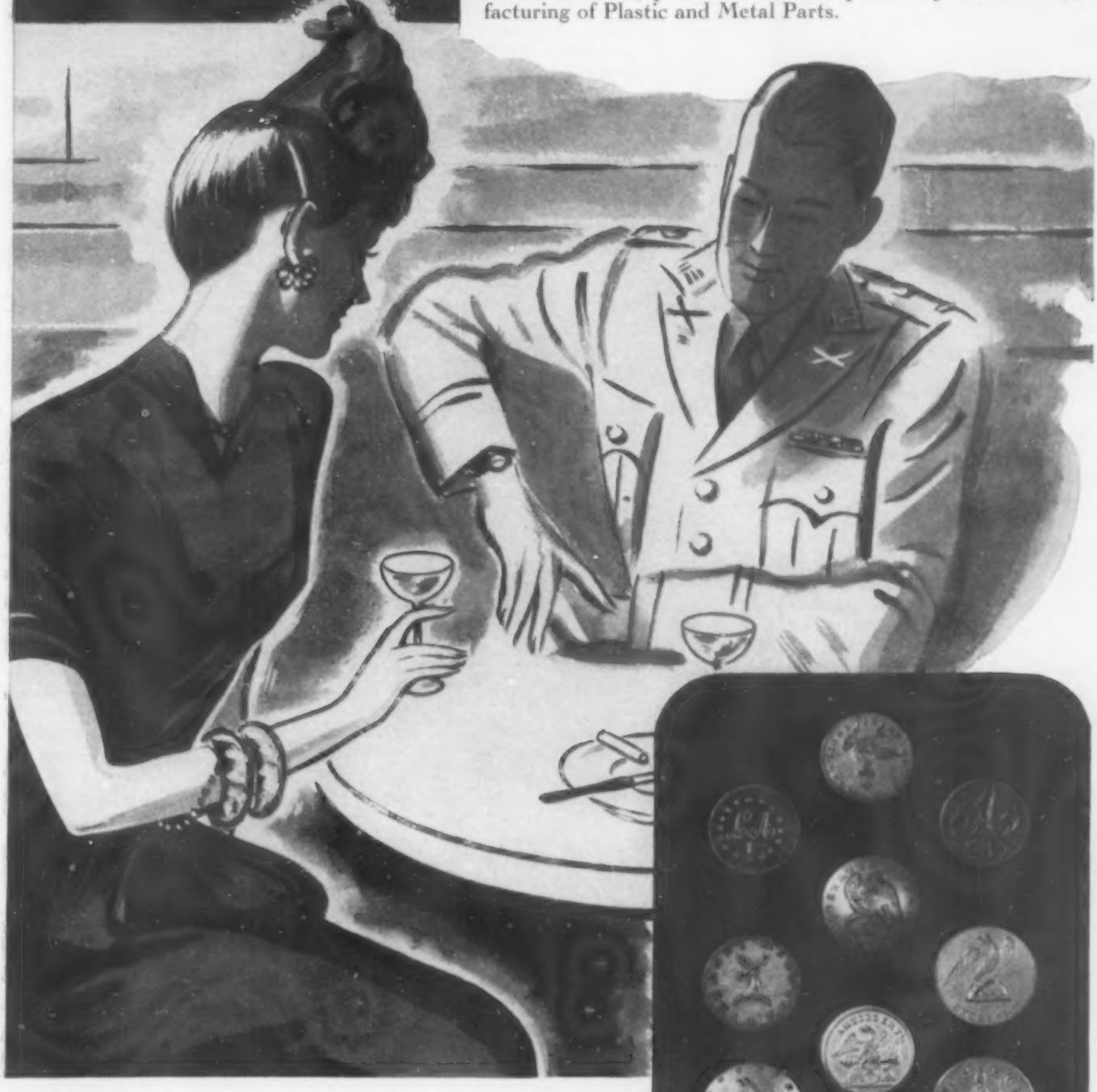
★ *A Toast* ★

TO THE MEN IN UNIFORM..
OUR AMERICAN SOLDIERS

● The proud distinction of wearing the uniform of an American soldier is born by millions of men in the Army and Navy. Never has the Government failed to provide them with the finest equipment, weapons and uniforms. It has been the privilege of this old established manufacturing company to supply the U. S. Armed Services with uniform buttons and other insignia since the War of 1812. We still do.

Buttons are but one of the many products of Waterbury Companies, whose large modern plants are equipped with the latest machinery for large scale production of Metal and Plastic products on a contract manufacturing basis for almost any purpose.

Waterbury Companies, Inc., with both Plastic and Sheet Metal Facilities, provides unified responsibility in the manufacturing of Plastic and Metal Parts.



From Waterbury Companies, Inc.
Museum of Early American Products

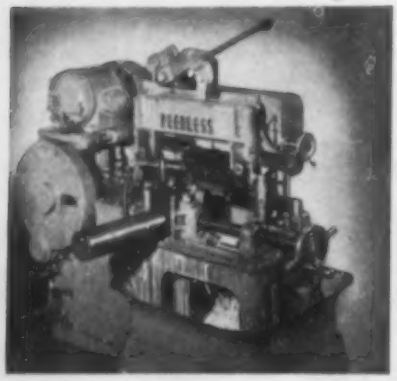
WATERBURY COMPANIES, INC.

FORMERLY WATERBURY BUTTON CO., EST. 1812

DEPT. B WATERBURY, CONNECTICUT

NEW MACHINERY AND EQUIPMENT

★ THE COMPACT, AUTOMATIC compensating feed unit on the new mechanicut saw produced by Peerless Machine Co., Racine, Wis., coupled with the four-sided saw frame and blade backing plate, is said to assure its users of a fast job of



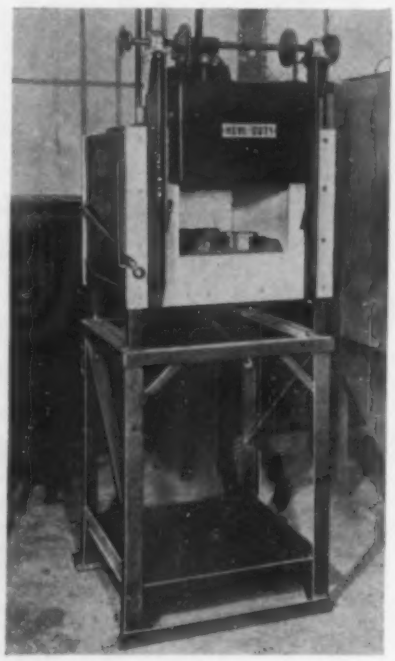
accurate cutting. Other features in the construction of the unit are: arch design, connecting rod and cross-head assembly, hardened ground ways, finger-tip feed pressure control, vise and table design, as well as three-speed gear transmission.

★ O'BRIEN STEAM SPECIALTY CO., Syracuse, N. Y., is producing a steam-mixer water heater which is compact and easy to install. The unit includes heater, temperature regulator, temperature-pressure relief valve, thermometer and, where necessary or desired, water pressure regulator and steam and water pressure gages. Designed for steam pressures of 50 to 150 lb., the machine utilizes the condensate as hot water and no condensation return system is required. Steam pipe sizes range from $^1/_2$ to $1^1/_2$ in., with capacities ranging up to 5500 g.p.h. The wide range of temperatures available makes the unit practical as a primary or booster heater.

★ INCREASED USE OF PLASTIC protective coatings has led Youngstown Miller Co., Inc., Sandusky, Ohio, to design two small plastic coaters to fill the need for suitable low-capacity heating and melting equipment. Both models are designed for use where coating of small parts or tools is necessary prior to shipment or during storage. The small units are said to have all the features of the large units necessary for proper and satisfactory use of plastic coatings. Each has a plastic pump arrangement which provides constant level in the dip tank and continual removal of the surface film and bubbles caused in dipping. Oil jackets the side and bottom of each tank, and both oil and plastic are thermostatically controlled, electric heaters shutting off when either reaches its ceiling temperature.

★ HARDNESS TESTING EQUIPment, designed by Glenn L. Martin engineers to replace standard equipment lacking in the greater flexibility and additional stamping and certifying units necessary for testing, is being manufactured by York Electric and Machine Co., York, Pa. Range of the unit is variable; impression or imprint can be made along any edge of the sheet in 2-in. intervals. The tester is equipped with removable anvil, standard anvil for sheets, and is capable of 43 imprints per minute.

★ TYPE MU-12148-A CONVECTION tempering furnace has been designed by Hevi-Duty Electric Co., Milwaukee, Wis., for the tempering of small work for production or the tool room, and for many low-temperature applications in the laboratory. Uniform temperature through



the charge is assured by a motor-driven fan located in the roof of the heating chamber. A standard controlling pyrometer provides accurate control of temperature at any point within the heat range of the furnace. The unit operates on 230 volts, 60 cycle, single-phase power. Where other voltage is to be used, a transformer may be supplied.

★ A CHIP SEPARATOR, WHICH separates chips of steel, brass, aluminum and plastics from finished parts after oil has been extracted, is being produced by McKenzie Engineering Co., Newtown, Conn. Size of parts to be separated may range from $^1/_8$ in. in diameter by $^3/_{16}$ in. in length to $2^1/_2$ in. in diameter and $4^1/_2$ in. in length. The operator need only empty the pan from the oil extractor into the hopper, and regulate the air blast with a lever to suit the size of the parts to be separated. The material is fed into the vibrator and spread, the parts shaken loose and the chips blown into a conveyor. The finished parts fall from a side chute into a separate box. The latest model is a low-built cabinet type, has heavy steel vibrators, steel hopper and self-feeder, and a blast gate in the ball-bearing blower. Repair parts are few and easy to duplicate.

★ FOR PROPER RE-REFINING OF oil, Gustin-Bacon Manufacturing Co., Kansas City, Mo., advocates the use of their Refinoil machine. This patented unit is claimed to be a miniature refinery, its process substantially paralleling the procedure used by refineries in the production of high-grade lubricating oil. The complete equipment of this machine includes: a glass-fiber insulated mixing tank; a retort heated by four elements of 6000 watts each; a condenser; a vacuum jet pump; a dilution tank of heavy steel-welded construction; a contact filtration and circulation tank; press, motor and pump; a machine frame and an Alsop electric agitator. Sixty to ninety percent of oil lost in drainage can be recovered through the use of this unit.

★ TAFT-PEIRCE MFG. CO., WOONsocket, R. I., is manufacturing a new snap-gage stand, designed to hold plain or thread gages. A stud-type clamp is employed to hold any make of snap gage at the necessary inclination for given work. A drilled hole in the base permits fastening to the bench if desired.

★ PRODUCTS OF PRECISION Paper Tube Co., Chicago, Ill., recently announced, include internal and external safeguards of threaded and machined parts and fittings. Thread protectors and dust caps made of spiral-wound fiber, kraft paper, or cellulose acetate, under heat-treated compression, are designed and constructed for greatest durability in protecting fittings, exposed openings and ends, and tubing, from moisture, rust, dirt, or damage in packing, storage or shipping.

★ BROKEN DRILLS WHICH FORmerly had to be discarded can now be reused with the aid of the C-B drill-saver, a device manufactured by C-B Tool Co., Lancaster, Pa. The broken end of the drill need only be slipped into the drill-saver, the device chucked-up, and drilling can be continued. Manufactured in 52 sizes, the drill-savers will accommodate standard drills from $^1/_8$ in. through #10.

Fashion Ideas... Molded in PLASTICS

You need never have any inhibitions about intricacy of design in a product to be molded in plastics if one fundamental rule is observed – *sound product engineering*. TECH-ART's engineers successfully meet the problems of intricate design day after day. With almost imperceptible modifications they engineer a designer's gossamer-like sketch into workable plans for TECH-ART's skilled mold builders. Then TECH-ART's vast molding facilities translate into four dimensions that which but a short time before was a designer's dream. Possibly we can assist you with that idea you may have for a product to be molded in plastics – add it to our ever-growing list of plastic success stories. Your inquiry is invited.

Another Plastics Success Story

These items are among those few which TECH-ART is molding today for civilian use. Brought to us by one of the country's leading handbag manufacturers to mold in a clear transparent thermoplastic material, they are typical of the infinite variety of civilian items which TECH-ART will mold in vast numbers into plastic success stories in the years of peace that lie ahead.

TECH-ART
PLASTICS COMPANY

36th Ave. and 41st Street • LONG ISLAND CITY, N. Y. • Tel. AStoria 8-6050-1
SUCCESSORS TO BOONTON RUBBER MANUFACTURING COMPANY
PIONEER PLASTIC MOLDERS . . . Established 1891

WASHINGTON ROUND-UP

R. L. VAN BOSKIRK, Washington Editor

Further curtailment of formaldehyde

The formaldehyde situation reached another crisis last month when its further use for urea resin for molding powder in civilian items was temporarily prohibited by the War Production Board. The measure was taken because severe storms which disrupted transportation had resulted in increasing shortages of formaldehyde. During this period, more than 5000 cars were reported stalled in the Buffalo area alone, to say nothing of places like Columbus and Cleveland.

The principal intention of WPB officials in issuing this order was to prevent the use of available formaldehyde for any but military purposes during the temporary emergency. It was not a further conservation effort on WPB's part, but an attempt to distribute what formaldehyde there was so that it would reach the most essential military end uses. It should be clearly understood that this aggravated situation was largely due to the inability of the railroads to deliver the supplies of methanol to formaldehyde producers.

The restrictions on phenolic materials were not quite so stringent. But this was only because almost all non-military orders have been weeded out or cut to the bone. Buttons and closures were hit most seriously insofar as urea molding powder was concerned—a condition that can be attributed to the fact that molders had previously been urged to switch from phenolic to urea. Curtailment of urea resin glue hit textiles and furniture particularly hard. Furniture manufacturers will be faced with prospective shutdowns because casein glue is now almost the only type available. Plywood for civilian use was almost entirely eliminated by the WPB action. As far as packaging is concerned another complication in the glue situation is that the Army has changed its specifications so that they now require urea rather than soybean glue.

Along with restrictions on urea, WPB placed similar limitations on the use of formaldehyde and methanol. Officials would not predict any time for prospective relief because producers are now faced with an increasing backlog of orders for military uses and it will take time to work them out.

The shipping tie-up was particularly aggravating because it came on top of the most severe shortage of these resins and molding powders that has been experienced since the war began—caused by insufficient supplies of methanol, formaldehyde and phenol to meet military demands for thermosetting plastic parts. Practically all available resins had already been allocated to military uses and irreplaceable civilian items.

Phenolic order amended and transferred

Control of phenolic compounds was transferred on January 16 from M-246 to general chemicals order M-300, Schedule 87. There were no important changes in administration except that there is no further authorization for the 2000 pounds formerly permitted for preauthorized orders. To replace that provision there is a clause allowing a 600-lb. small-order exemption as compared with the previous 50-lb. small-order exemption.

More restrictions on manpower

The manufacture of plastics raw materials has been listed as a critical activity, but there is no direct listing for molders, laminators and other processors, as such. Their workers' status for deferment depends upon what the worker is making, and even then there is grave doubt as to whether he will be deferred, despite the fact that he may be working on such items as rockets and fuzes, if he comes within the 26 through 29 age group. The percentage of war work in a plant won't make much difference unless it is 100 percent, for the Government is likely to say: "Take men off civilian production to replace any who may be drafted."

It must be remembered that the draft quota is a local board problem—they will fill that quota according to their needs. Thus a man in one area working on phenolic production for war goods might be inducted while a man working on similar production in another area would be deferred. The point is that plastics workers under 30, either in raw materials or processing, do not have much chance of deferment in the new draft program, despite the listing as critical or essential, unless it can be definitely proved that they are engaged in strictly war production. And even if the worker is engaged in war work he may still be inducted (unless engaged in vital research) if his community's draft board cannot find enough men to fill their quota from unessential industry. The Government's critical list is only a guide for local boards and in effect tells them they should not take the men on this list until all other sources have been exhausted. However, it is doubtful whether there are enough remaining men in the unessential industries to fill the recently announced high quotas.

It is not too early for suppliers and processors to start thinking about the effect of this situation on their production in the near future and thus be prepared to ask for help from the local WPB office if they see any indications that local boards in their area are likely to have trouble filling their draft quota. The M-52 program, for example, is requiring more and more workers. It is highly important that local WPB offices be apprised of such conditions so that their aid may be enlisted in keeping production of war goods at top levels.

Acrylic sheet restrictions tightened

To safeguard adequate supplies of all grades of cast sheet of acrylic monomer and acrylic resin for the military, the WPB placed these sheets under allocation control of Schedule 17 of Order M-300 on Jan. 13, 1945. Formerly only the specification grades of cast sheet for use in aircraft were placed under control of the order.

This action was accomplished by amending Schedule 17 (Acrylic Monomer and Acrylic Resin) to redefine cast sheet to include all cast sheet instead of only the clear uncolored specification-grade cast sheet. WPB pointed out that although all grades will be under allocation control of the order, material that is not required for military uses or for specific industrial uses of high essentiality will be given a blanket release under paragraph (f) of Order M-300. In general, they added, there will be no apparent change in the civilian distribution of the cast sheets.

Toothbrushes

A situation of more than usual interest has arisen in the toothbrush industry. Nylon for bristles, one of the tightest of all plastics materials, has been allocated in sufficient quantity to take care of demands for the quarter, as seen by the Office of Civilian Requirements. But acetate and nitrate, used for brush handles, and formerly in much freer supply than nylon, are not available to supply all demands. As a health item, toothbrushes rate high in essentiality and there has been considerable uneasiness because material for handles is so difficult to obtain.

The principal reason why there is not enough acetate is that military demands have steadily increased and there simply is not enough material to supply all civilian needs. Under paragraph (f), suppliers distribute the acetate which is left after military orders are filled. Under present circumstances, the only way that enough acetate can be found to fill present requirements would be for WPB to allocate a specific amount for toothbrush handles only. (*Please turn to page 210*)

STOKES "STANDARD" PRESSES

THEIR SAVINGS WILL MAKE TOMORROW'S PROFITS

USERS SAY:

"...240 more pieces per hour per 24-cavity mold on Stokes Standard Presses."

"...Rejects less than 2% on precision pieces."

"...30% greater production due to automatic time cycle."

"...Standard Presses protect molds, reduce mold maintenance."

"...Controlled closing speed ideal for delicate pieces and precision work."

"...One man attends battery of standard presses."

Interested in saving molding labor? Increasing press output up to 30% or more? Reducing rejects to the very minimum?

Then do as many modern molding plants have. Install Stokes "Standard" semi-automatic Presses.

"Standard" Presses are complete self-contained units. Low hydraulic pressures (500 to 1100 lbs.), with accompanying freedom from leaks and high maintenance costs, actuate triple-toggles to produce desired molding pressures (up to 300 tons). Presses are flexible . . . readily adjustable to meet exact pressure requirements of the mold. Because of toggle action presses are quick-acting, automatically slowing down and closing only as fast as material will flow. There's no "cocking" of mold, no excessive wear and tear on mold inserts. One "finger-operated" four-way valve controls entire operation. One operator frequently runs up to six presses—the press closing, breathing, curing, opening and ejecting automatically. Split-second timing of these operations are responsible for securing from 30 to 50 per cent more heats per hour, multiplying production. Many other cost-cutting features. Built in six sizes from 20 to 300 tons capacity.

F. J. STOKES MACHINE CO.
5934 Tabor Road Philadelphia 20, Pa.

F.J.Stokes MOLDING EQUIPMENT

FJS Est. 1895

NEWS OF THE INDUSTRY

★ SHELLMAR PRODUCTS CO., MT. Vernon, Ohio, has acquired control of the Swedlow Aeroplastics Corp., Glendale, Cal. The latter will be operated as a division of the parent company and will continue to make its headquarters in California. Shellmar Products Co. is well known in the packaging field as one of the nation's largest fabricators of flexible packaging materials. It is now engaged largely in the production of war materials, including the famous gas cape, airplane engine envelopes and lamination of many other materials for the protection of food, war matériel, etc. The president of the Shellmar Products Co. is B. W. Martin; vice-president and general manager, P. M. Gilfillan.

Dave Swedlow, formerly president of Swedlow, continues as manager of the plastics division and plastics product development, while Ted Swedlow remains Director of Sales and Sales Promotion of the Swedlow Division. The pooling of the facilities of the two companies as well as their skill, know-how and capital, will enable the company to do a more comprehensive job in the plastics industry, not only for the war effort, but also for the postwar period.

★ THE NEW YORK CITY OFFICES of Rohm and Haas Co. have been moved to 11 West 42nd St., where the company will be represented by D. S. Plume and H. L. Stauffer.

★ DAVID L. EYNON, JR., MANAGER of the Longhorn Ordnance Works, Karnack, Tex., a government plant operated by Monsanto Chemical Co., has been promoted to assistant to the general manager of the company's Organic Chemicals Div. He will be responsible for all Monsanto operations at Karnack. Mr. Eynon will be succeeded by Robert K. Mueller, general superintendent of production at the Karnack plant.

Other appointments in the Organic Chemicals Division announced were Dr. Franklin D. Smith, assistant director of development; William M. Russell, branch manager for the Detroit, Mich., territory, and C. H. Somers, Jr., manager of plasticizers and resins sales.

★ A NEW PLASTIC, PRODUCED BY Westinghouse Electric and Mfg. Co., E. Pittsburgh, Pa., and known as Micarta 444, combines both the desirable molding properties of thermoplastics and the physical characteristics of thermosetting materials.

The plastic, a modification of standard Micarta, softens when hot, but at a much higher temperature than thermoplastics. Lower pressures and shorter curing cycles than those of thermosetting resins are added advantages.

★ A WIDE RANGE OF POSSIBILities for their new series of synthetic rubber molding powders, which become vulcanized at 300 to 360° F. is claimed by Thiokol Corp., Trenton, N. J. The solid formed from these powders is said to have the physical properties of vulcanized rubber and, in addition, excellent resistance to solvents, greases, oils, fuels, sunlight, ozone and atmospheric oxidation. The compounds retain their flexibility at temperatures below −50 and above 220° F.

★ HERCULES POWDER CO., WILmington, Del., has created a subsidiary, Hercules Powder Co., Ltd., for the distribution of technical information in Great Britain and Eire. Offices, located at 140 Park Lane, London, will be under the supervision of Cornelius H. B. Rutteman, managing director. Other directors named are: Thomas H. Cooke, Holden Vale Manufacturing Co.; R. H. Oxley, London branch, Bankers Trust Company of New York; Kenneth D. Cole, Messrs. Linklater & Paines. The London office will assist customers and distributors with data and technical service on the use of Hercules cellulose derivatives for lacquers and plastics, terpene and rosin chemicals, synthetic resins for protective coating and other industries, and paper makers chemicals. Manufacturing operations of the Hercules Paper Makers Chemical Department will be continued at Erith, England.

★ S. SIDNEY ULLMAN, FORMERLY head of plastics unit, OPA, Washington, D. C., has returned to practice as tax counsel in Federal administrative agency matters and accountancy. His office will be located at 67 West 44th St., New York, New York.

★ E. L. FEININGER OF THE SCHENectady, N. Y., office, and W. H. Milton, Jr., Pittsfield, Mass., have been named assistant general managers of the chemical department of the General Electric Company.

The department will be located in Pittsfield under the supervision of Mr. Milton. Mr. Feininger will continue in Schenectady, in charge of the Resin and Insulation Materials Division. Other appointments to the department were those of Don S. McKenzie as general sales manager, Robert L. Gibson as advertising and sales promotion manager and Harold P. Smith as auditor.

★ G. GORDON URGUHARD HAS been named president of Wilmington Chemical Corp., New York, N. Y., to succeed Herbert Waller who recently resigned. Henrik J. Krebs, formerly secretary and a director of the firm will become treasurer, succeeding A. D. Bestebreurtje, who has also resigned. Both Mr. Waller and Mr. Bestebreurtje will remain as directors.

★ THE NEW YORK OFFICE OF Universal Plastics Corp. is now located at 270 Madison Avenue.

★ AMBERLITE PR-245, A NEW ADhesive produced by Resinous Products and Chemical Co., Inc., Philadelphia, Pa., promises to lower plywood production costs by cutting the bonding and assembly time of hardwood plywood. The resin is a thermosetting phenol-formaldehyde in dry powder form, which is readily soluble in water, in alcohol or in mixtures of alcohol and water.

★ KENILWORTH BUTTON MFG. Co., Kenilworth, N. J., has been succeeded by Kenilworth Plastics Molding Co., a department of Eureka Button Co. There has been no change in partners or status of the firm.

★ ANNOUNCEMENT IS MADE that A. T. Steele, representative of American Cyanamid Co. in the Chicago area, is now permanently located at 3270 Lake Shore Drive, Chicago, Illinois.

Sale of the company's resin adhesive products and other resins for use in the woodworking industry in Canada will be handled by an affiliate company, North American Cyanamid Ltd. of Toronto and Niagara Falls, Ontario, under the supervision of T. Kelly Pierce.

★ PRECISION PLASTICS CO. ANnounces that its office and plant have been relocated at 4647-61 Stenton Ave., Philadelphia, Pennsylvania.

★ B. F. GOODRICH CO., AKRON, Ohio, announces the appointment of J. E. Thomas as manager of the Industrial Products Sales division. In this capacity Mr. Thomas will direct the sales of all the adhesive materials being handled by the division.

★ IN ACCORDANCE WITH A planned expansion program, Detroit Mold Engineering Co. has moved its offices to the factory at 6686 E. McNichols Rd., Detroit, Mich., where a complete new plant building has been erected.

(Please turn to page 214)

THAT'S A question that you will want answered correctly before you decide upon molded plastics. But . . . it's a question that must be considered from several angles.

In many cases, the total cost of mold and molded parts is less than that of other materials. In other cases, though the first cost may be more, the plastic part may be so designed that one or more important finishing and assembly operations are eliminated, thus showing exceptional savings in the final cost. Again, the physical properties of a molded plastic part may so improve operation that any additional cost is overshadowed by improved performance.

The best way to know—in advance—the facts about comparative costs, is to call in a CMPC Development Engineer. He's one of a group of specialists in plastics molding. He will study your problem, make unbiased recommendations, and give you an estimate of the total cost. And, if it proves to be a practical application for plastics, he will continue to work with you in matters of design, engineering, and choice of materials, providing personal supervision of your job throughout planning and production.

Why not ask for the services of a CMPC Development Engineer today? There's no obligation.

We've been at it for over 25 years

CHICAGO MOLDED PRODUCTS CORPORATION

1046 N. Kolmar Ave. Chicago 51, Illinois

COMPRESSION, INJECTION, AND TRANSFER MOLDING OF ALL PLASTIC MATERIALS

Temperature stability

(Continued from page 156) of boiling water. This unusual behavior is probably caused by the moisture loss that occurs in the neighborhood of 100° C. and the consequent changes in physical properties that take place thereafter.

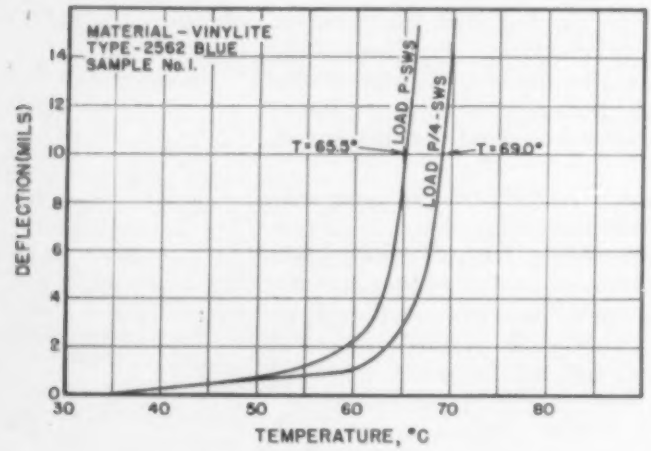
Among the so-called thermosetting materials, Allymer resin (C.R.-39) is peculiar in having an unusually low cumulative heat-distortion point and no noticeable change in rate in and above the general neighborhood of the heat-distortion temperature.

Saran and nylon appear normal in the sense that they have heat distortion points in the expected range for thermoplastic materials, yet their low rate of deflection increase with temperature shows that they are singular with reference to their class. It is readily evident from Fig. 3 that saran does not flow as readily at elevated temperatures under load as the other thermoplastics, and that nylon is even less sensitive to temperature changes than most thermosetting materials in the neighborhood of 150° C. and above.

The distinctive behavior of nylon and saran is also indicated by the data of Tables II and III. In Table II, for example, the difference between the columns is indicative not only of the differences in expansion coefficient among the different materials, but also of the rates at which specimens deflect with respect to the temperature in the neighborhood of their distortion points. Inspection of the table shows that nylon, in particular, and saran, in less measure, are unusual in this latter respect, while the other thermoplastic and thermosetting materials are more or less uniform in deportment.

Table III, which gives the heat-distortion points at various loads, also shows the singular behavior of saran and nylon. For example, the difference in cumulative heat-distortion temperature between full and 1/4 loads is less than 30° C. for all plastics listed except these two. The difference ranges from only 3° for Vinylite to about 28° for Resinox. For

11—*Comparative temperature-deflection and temperature-deflection rate curves for the different loads applied to the plastic specimens in the third series of tests*



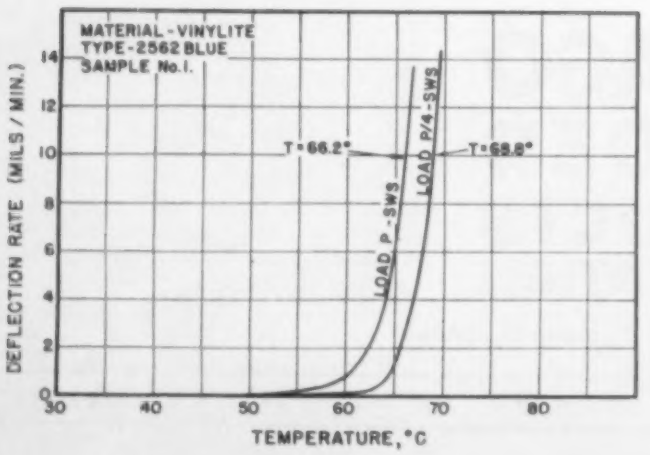


TABLE II.—COMPARATIVE HEAT DISTORTION TEMPERATURES OF VARIOUS PLASTICS USING A.S.T.M. AND MODIFIED APPARATUS

Material	*Heat-distortion temperatures*		
	A.S.T.M. apparatus	*Modified apparatus*	*Difference*
	° C.	° C.	° C.
Cellulose acetate butyrate			
(Tenite II-006AS$_4$)	58.9	56.4	2.5
(Tenite II-008AH$_4$)	70.0	69.5	0.5
Polymethyl methacrylate			
(Crystalite Y-100)	79.0	77.4	1.6
Vinylidene chloride			
(Saran)	67.5	61.3	6.2
Polyamide			
(Nylon FM-1)	82.5	61.5	21.0
Phenol-formaldehyde			
(Textolite 1854)	130.0	127.5	2.5
(Resinox D-6)	124.0	119.0	5.0

TABLE III.—HEAT-DISTORTION TEMPERATURES OF PLASTICS UNDER VARYING LOADS

Material	*Load*	*Heat-distortion temperatures*	
		Cumulative	*Rate*
		° C.	° C.
Vinylidene chloride (Saran)	Full	61.0	123.5
	1/4	108.0	?
Methyl methacrylate (Plexiglas)	Full	76.2	81.0
	1/2	79.5	84.0
	1/4	83.0	85.9
Ethyl cellulose (EC # 2)	Full	52.5	65.8
	1/2	60.1	78.5
	1/4	66.0	84.4
Phenol-formaldehyde (Opalon D-5)	Full	79.0	82.0
	1/2	83.9	112.4
	1/4	85.0	143:0
Phenol-formaldehyde (Resinox D-6)	Full	121.8	162.5
	1/2	143.8	...
	1/4	150.0	...
Cellulose acetate (Fibestos D-10)	Full	51.5	54.3
	1/2	60.2	66.5
	1/4	63.0	72.0
Polyamide (Nylon type FM-1)	Full	80.5[a]	...
	1/2	105.0	...
	1/4	169.0	...
(Nylon FM-1)	Full	61.5[a]	...
	3/4	72.0	...
	1/2	90.0	...
	1/4	146.0	...
Vinyl chloride acetate (Vinylite W-2652)	Full	66.0	67.3
Cellulose acetate butyrate (Tenite II-201 AMS)	Full	58.0	75.0
	1/4	77.0	88.0

[a] Nylon samples taken from different batches.

An Important Plastics Announcement BY DOW

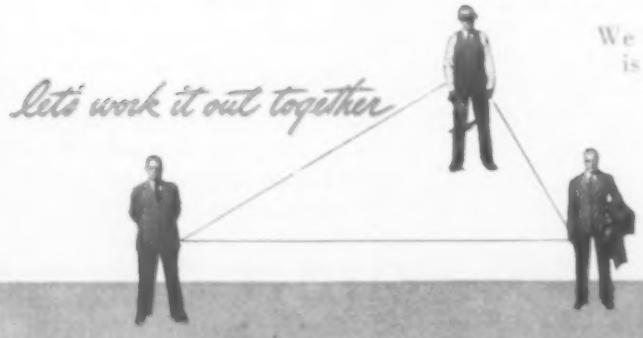
STYRALOY

A NEW PLASTIC FOR INDUSTRY

Highly significant among countless new materials developed for war requirements is Styraloy—trade-mark name for a remarkable group of plastics possessing properties intermediate between rubber-like materials and rigid thermoplastics.

"Working it out together" with the Armed Forces, Dow developed the first of this impressive new line——Styraloy 22—to provide a one-piece cable sheathing with a low power loss at high frequencies and possessing great durability and flexibility. These unique qualities—combined with others presented below in capsule form—point to its use in a broad range of products. As a result, unlike many war-born materials, Styraloy anticipates a peacetime career of great importance.

Now that Styraloy is available for commercial purposes, molders and manufacturers or designers will find Dow equally willing to cooperate with them in developing to the fullest extent the numerous applications indicated by the impressive list of Styraloy's properties. "Let's work it out together."



We at Dow know from experience that success in plastics is not a one-man nor even a one-industry job. It calls for the combined skill and cooperation of manufacturer or designer plus fabricator plus raw materials producer. Working together, this team saves time and money and puts plastics to work successfully. Call us—we'll do our part.

PRESENT AND POTENTIAL USES: One-piece cable sheathing; handles for tools, household appliances, etc.; gaskets; bushings; coil forms; floor mats; scuff plates; many applications still to be ascertained.

PROPERTIES AND ADVANTAGES: High dielectric strength, low power loss over all frequencies. Power factor only .005 at 100-300 megacycles. Flexible and shock resistant from —90° F. to 212° F. Specific gravity less than 1 (floats in water). Water absorption only .2 to .5%. Resists heat, ozone, and most chemicals. Highly resistant to abrasion. Resists permanent indentation. Ideally suited to extrusion of complex cross sections and readily fabricated by other molding techniques. Easily machined.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit
Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle

DOW

PLASTICS

STYRON • ETHOCEL • ETHOCEL SHEETING
SARAN • SARAN FILM • STRIPCOAT • STYRALOY

saran, however, the difference is over 50° and for nylon over 80°. These differences are of the same order of magnitude, especially for thermoplastic materials, as the differences between the cumulative distortion temperatures and the rate-distortion temperatures.

It is evident that distinctly wrong impressions would be obtained relative to the temperature stability of the various plastic materials if only a cumulative heat-distortion temperature were measured. In order to evaluate properly the merits of each material, it is best to record the complete variation of deflection with temperature. However, this procedure is not absolutely necessary, and either a separate tabulation of both cumulative and rate distortion temperatures or a tabulation of cumulative distortion temperatures at both full and quarter-load should be sufficient to enable fairly accurate evaluation of the relative temperature stability of stressed plastics.

Walking on air

(*Continued from page 118*) anatomically the foot for which it is designed. The matter of elevation was one of the most difficult to solve—a low elevation support is not suitable for a high-heel shoe because it will rock on the shank and tend to push the foot upward. Consequently it was necessary to resort to the use of three different elevations so that a support would correspond to the pitch of the heel height of the shoe. This, of course, tripled the number of items in the line.

Among the features appealing to buyers is the supports' average weight of only 2 ounces. This is quite a bit less than the weight of supports made of leather, metal or a combination of the two. And there is no practical limit to the weight these laminated plastic arches will support. The supports have a glossy smooth, attractive blue-white finish; they are cool in summer and warm in winter; they can be worn in any shoe with the correct heel height; they are long wearing; they are easy to keep sanitary and odorless.

The design of the supports includes a cupped heel and a flange at the upper side—two features which contribute to the strength of the arches and to their easy fitting and comfort.

The flange is likened by Dr. Scholl, president of the company, to "an extra span in a bridge" in giving the added strength which is needed not only to make the plastic supports of unquestioned practical value but to overcome a hesitancy on the part of both dealers and retail buyers to accept a plastic support of such light weight and resiliency. As a result of this special construction, the company has encountered no difficulty in meeting all sales resistance, and in conclusively demonstrating that no trouble whatever will be found with the strength of the support.

The supports are 100 percent laminated plastic—no metal or other material is used in any section of the construction.

Another feature of the supports is that the user or dealer can make minor adjustments in shape since the material is thermoplastic and can be formed to a certain degree when subjected to heat. Such alterations are sometimes necessary in cases where it is advisable to remove the pressure point of the flange from the side of the foot. Instructions supplied with the supports show how these adjustments can be made by immersing the supports in boiling water and then forming them to the proper shape by hand.

After collaborating with a number of plastics and orthopedic authorities in designing the laminated supports, Dr. Scholl decided on a preliminary program of test fittings and wearings. This research work was conducted with the cooperation of various shoe dealers scattered over the country and covered a period of more than two years. At the end of this period a complete advertising and merchandising program was prepared which included a complete lineup of newspaper ads in various sizes, window displays, counter displays and other merchandising tieups. Later, when the sales program was well under way, advertising in a number of national magazines was added.

The first step in the sales program was the introduction of the laminated supports through 17 company-owned foot-comfort shops which handle Dr. Scholl shoes as well as all other Dr. Scholl foot appliances, preparations and remedies. Each of these stores had a complete stock of the 618 sizes and shapes, and the campaign was supported by aggressive local newspaper campaigns. The next step was the expansion of the program to dealer-owned shops. Then came the introduction of the laminated supports to the Dr. Scholl service departments in department stores, and finally to shoe stores throughout the country. In all cases, newspaper space was used liberally.

Because of the difficulties of stocking a large number of sizes and shapes, it is not planned to introduce the supports in drug or variety stores, though stores having surgical and truss departments are deemed logical outlets. Despite the fact that the Scholl sales organization is world-wide, the supports are not being introduced outside the United States at this time—principally because of production limitations.

Credits—Material for laminated support: Laminex. Molded and merchandised by Scholl Mfg. Co., Inc.

Boosting the box score

(*Continued from page 137*) diameter window opening as well as a $^{7}/_{8}$-in. diameter hole. A loose threaded pin is used to mold a threaded hole with a diameter of $1^{3}/_{4}$ in. and to hold a $^{3}/_{4}$-in. threaded insert in place during the molding. Three other side-screw pins support additional threaded inserts.

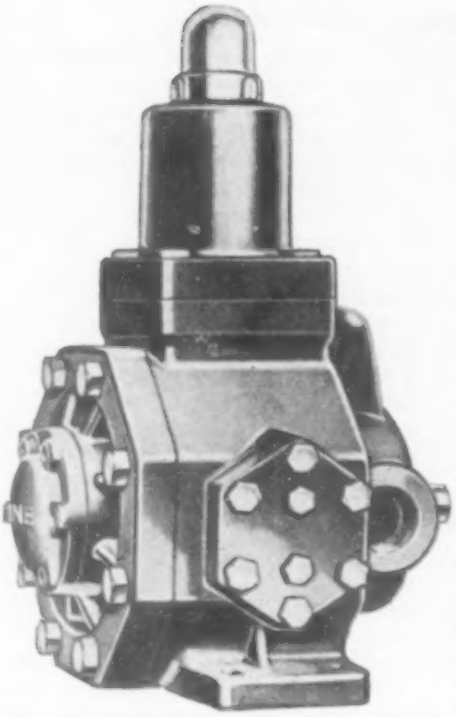
The $4^{1}/_{4}$ lb. of a very high-impact phenolic material of the impregnated string type, which is needed to fill out the cover, is preheated for 10 min. at 225° F. On the basis of past experience, the molder decided that preforming of this material could be dispensed with. However, because of the high bulk factor of the plastic, the operator needs a good-sized pail to handle this large amount of material (Fig. 2). Considerable skill is demanded of the operator during the loading of the mold, inasmuch as the material cannot merely be thrown into the cavity but must be carefully allocated to different parts of the mold. The operator places the plastic in the cavity a handful at a time, tamping and pressing the correct amount into the designated section of the mold.

The cure time for this gun-director cover is 11 min., with the mold maintained at a temperature of 320° F. The size and thickness of this molding makes chilling unfeasible. Instead, the molded part is clamped on a cooling form and shrink plugs inserted in the round and rectangular window. In this manner, the dimensions of the part are held very accurately. According to an engineer at Sperry's, total warpage variation on these covers is 0.002 in. per inch.

Just before the mold is opened (Fig. 3), the threaded insert pins are unscrewed so that the mold can operate. In the meantime, the cam actuated bars pull the plugs from the

Variable volume

OIL HYDRAULIC PUMPS



50 to 1000 lbs. pressure

1 to 30 gal. per minute from one pump

RACINE "Variable Volume" Pumps supply only the needed volume of oil—no more—no less. Volume control can be regulated automatically or manually.

This equipment supplies the exacting needs of operations requiring variation in volume and pressure. Because both these features are incorporated in a single pumping unit, the cost of the initial installation is less. Continued savings are provided through lower horsepower consumption in daily service. Correct design, precision workmanship, rugged construction and overload capacity insure long life.

RACINE "Variable Volume" Oil Pumps are built in three capacities: 12, 20 and 30 gallons per minute, all designed to deliver pressures up to 1000 lbs. P.S.I. Let our experienced factory engineering staff and field engineers supply recommendations for developing and improving your oil hydraulic circuits.

Write today for our catalog P-10-C. At the same time outline your problem. Full information will be supplied without cost to you.

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RACINE ECONOMIES

- ★ No oil heating loss through pumping excess oil.
- ★ Relief valves are eliminated, the Pump varies the volume.
- ★ Less horsepower required—because no excess oil is pumped.
- ★ Tilted multiple vanes of special design reduce ring and rotor wear.

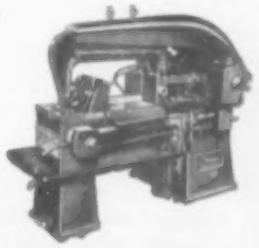
SLEEVE TYPE VALVES REDUCE CIRCUIT SHOCKS

RACINE's complete line of Oil Hydraulic Valves utilize a sleeve design. When these valves are operated, the flow of oil is gradually measured or tapered off—shock present in valves with quick closing ports is eliminated.

Sleeve design also provides the advantage of variation in porting arrangements. RACINE Control Valves in ⅜" to 1½" standard pipe sizes. Manual, mechanical or electrical control devices can be provided.

The Production Saws of Modern Industry

Use RACINE Metal Cutting Machines for your metal sawing operations. Models for general shop work as well as heavy duty production jobs. All price ranges and capacities—6" x 6" to 20" x 20". May we send you catalog No. 12 on RACINE Metal Cutting Machines?



STANDARD FOR QUALITY AND PRECISION — RACINE — RACINE TOOL and MACHINE CO.

RACINE

large window opening and from the $^{7}/_{8}$-in. diameter hole. As soon as the cover is removed from the mold, it is clamped into position on the shrink block and the threaded and smooth shrink plugs inserted (Fig. 4). Figure 5 shows the setup for the several drilling and tapping operations which must be carried out before the part is ready for a coating of Navy paint. Drill jigs are used in every instance so that there is never any question as to the accuracy of the location of these holes. Figure 1 shows front and rear views of the molded cover after it has been given its final coat of Navy paint and is ready for assembly.

This cover is now performing satisfactorily in every theater of the war. It is strong, light in weight and corrosion resistant. A neoprene gasket fitting snugly into a recess molded in the plastic cover acts as a seal against any water that might otherwise seep between the edges of the cover and the chassis. Despite the extreme weathering to which these plastic covers are subjected, no complaints regarding the performance of the gun directors have been attributed to the use of plastic rather than aluminum covers.

Credit—Material: Bakelite, Drackett and Resinox. Molded by Taunton plant, General Electric Co. and Reynolds Spring Div., Continental Can Co., for Sperry Gyroscope Co., Inc.

Machinery maintenance

(Continued from page 148)

A check list of general maintenance routines is given at the end of this article. Do you have a regular schedule for checking these items? Does your operator report at once any erratic operation of his machine? Do you have facilities for immediate minor repairs? Are these repairs done at once, or do you let them go till they contribute to a major breakdown? Are you imposing undue strains on your injection machines by overly severe clamping, too many cavities, etc. Do you fully appreciate the delays to production in not anticipating wear or failure of expendable parts?

In the answers to simple questions such as these lies the immediate future of our injection industry and its ability to maintain the output of war-vital parts. And any maintenance system put in under the emergency will bear continuing returns in increased profits when injection molding again turns to production of civilian items.

Maintenance Check List

The hydraulic system

1. Periodic inspection of oil level.
2. Regular use of oil filter.
3. Periodic change of oil of recommended make and viscosity.
4. Check water lines to mold. Can this water possibly get into the hydraulic oil tank?
5. Check water lines to thermoset injection plunger, where used.
6. Check disposal of oil seepage and leakage at machine drains. Always filter (not just decant) this oil before reuse.
7. Do operators promptly report all minor leaks so that maintenance can check them at once?

Moving parts

1. Set up regular schedule of lubrication for all parts requiring pressure-gun lubrication. Delegate responsibility for lubrication and provide check up on the routine; setting it up is not enough.
2. Set up schedule for filling automatic lubrication system, if any, at regular interval. Secure regular report on condition of all feeder lines in automatic system.
3. Provide check chart of all correct greases and oils as suggested by oil salesman of recommended supplier.
4. Provide monthly schedule of inspection and lubrication of pump and motor bearings.
5. Provide lubrication for flexible coupling between pump and motor.
6. Have foreman make periodic report on the condition of the safety gate, machine covers, and all other protective equipment.
7. Tighten all cylinder heads at 3-month intervals to prevent gasket troubles. Take up on all packing glands for wear and expansion.

Spare parts and tools cabinet

1. Have a regular place and an individual designated as responsible for all standard wrenches and other tools used around the machines, especially nozzle wrenches, spanner wrenches and other single purpose tools.
2. Have a regular check up on all tools for set-ups in order to speed mold change time.
3. Secure a spare heater for each machine if possible.
4. Stock certain hard to get parts, e.g.:
   a) spare time clocks.
   b) spare gaskets and packings.
   c) spare heater bands.
   d) spare relays and tubes for pyrometer.
   e) spare pump parts.
   f) spare solenoid coils.
5. Set up a record of down-time due to machine trouble, of spare parts used, of reordering your spare parts to keep a minimum inventory.

Miscellaneous

1. Schedule a regular time each shift for cleanup of machine and floor.
2. Schedule a set time each week for a thorough cleanup of entire machine, inside and out.
3. Inspect pyrometer and thermocouple equipment for loose connections, frayed wires, etc., at definite intervals. Calibrate instruments at regular times, and reset zeros.
4. Check level of machine to make sure settling or loosening of leveling screws or hold-down bolts has not thrown a slight twist into it.
5. Keep a record of suggestions as to desired design changes, weak spots, excessive maintenance costs, etc., in connection with your injection machines, and give them to your machine supplier for his suggestions, comments, and possible action.
6. Provide a definite method of checking up on all the good resolutions you may have upon finishing this article, and make sure that each suggestion is followed up until it becomes a habit, not only in yourself, but in each man who will have anything to do with the handling of your injection molding machinery.

Keratin—a modifier

(Continued from page 160)

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(Please turn to next page)

AS ADVERTISED

We have been talking about ourselves for a couple of years via these advertisements in MODERN PLASTICS.

We have claimed leadership in the extruding field. *True.*

We have told you about some of the unusual extrusions we have originated and engineered for aircraft, automobiles, furniture, agriculture and for the war effort generally. *These too are true.*

We have talked about the way we do business—that we will not take on a job merely because there is money in it, if we are not satisfied that it is a good application. *It's a fact.*

The best way to test these statements is by trying us out. *We are ready to back them all up.*

We also do injection molding.

DETROIT MACOID CORPORATION

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Detroit, Michigan

SOCIETY OF THE PLASTICS INDUSTRY · SPI

ORIGINATORS OF
DRY PROCESS PLASTIC EXTRUSION

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Propaganda . . .

(Continued from page 94) this type of shoe has steadily increased in use, and it is expected that its acceptance will continue and grow after the rationing of leather shoes is lifted. The fact that some play shoes, especially those with heavy hemp or good plastic soles are very durable, put them on the rationed list."

What about these "plastic" shoes so scornfully classed as substitutes? Upon checking with a major plastics material supplier, MODERN PLASTICS learned that a good many so-called "plastic soles" contain an infinitesimal amount of resin; the balance being made up of such fillers as cotton flock, leather dust, carpeting waste—and other fillers which defy identification. Other soling is compounded from contaminated material or made from formulations totally unsuitable for shoes. Wire and cable insulation scrap, a common source of material for shoe soles, usually contains plasticizers which technicians have pronounced "all wrong" for shoe soles.

Furthermore, as pointed out in the Dept. of Commerce reports, the merchandiser will attempt to dispose of this undesirable merchandise under conditions that will create the least amount of ill will for himself. To cover up his own inexperience and ignorance, he labels it a "substitute," shrugs and complains, "It's all we can get—there's a war on!"

And there is a war on by the plastics manufacturers who have been carefully experimenting with specially created shoe-sole material which has shown remarkable wear in field and laboratory tests, excellent abrasion and weather resistance, and will withstand over 4 million flexes at room temperature before cracking. And they are prepared to back up their tests with consumer reactions such as the following from parents whose children wore shoes soled with plastics that were custom made for the purpose. The following comments are indicative of the reactions of many housewives to plastic soles.

"These soles have worn much better than any other type of sole for my daughter. However, she plays on concrete all of the time as even the school yard is paved with concrete, otherwise I am sure they would have worn much longer" (9-year-old girl after 16 weeks' wear).

"He has a tendency to wear shoes at the side and these resisted that more than ordinary leather. Can it be put on the heel, too? He is especially hard on ordinary shoes which have to be resoled every $2^1/_2$ weeks" (6-year-old boy after 9 weeks' wear).

Here are the testimonials that must counterbalance the prejudices which "ersatz" has built up, but *this type of careful preliminary testing will be the prime essential for the production of quality merchandise.*

This same series of Dept. of Commerce reports mentioned above, contains other comments demanding serious consideration, since they turn the spotlight on other blunders for which the plastics industry will be paying for a long time.

"Ersatz lines have constituted less than 10 percent of the stock of most hardware stores. In some cases, plastics have been substituted for metal in kitchen and household equipment. In a few of these instances the change has been satisfactory; in others it has not. Inability to resist heat is the major defect of these plastic kitchen accessories. Wood also has been used as a substitute for metal in household items. These lines are generally of inferior grade inasmuch as they are clumsy and awkward to handle and are easily damaged.

"Generally speaking, hardware merchants, at least in the better neighborhoods, do not find it desirable to stock the substitute type of merchandise. Since they rely on an established group of customers, some loss of sales is preferable to damaged good will. However, it is reported that stores which have aggressive promotion policies and are located on traffic arteries may be able to dispose of a larger percentage of their war created merchandise.

"Hard rubber combs have been off the market for a long time. Consequently the druggist has had to turn to plastic combs. Even these are limited in supply, particularly the better grades. Retailers buy all they can of the nationally known combs but are wary of the unknown brands.

"Wary druggists are purchasing cosmetics packed in metal or plastic containers, including compacts and lipsticks, with considerable care because they have learned from experience that many of the cases are of inferior quality."

From other sources we find echoes of disappointment in plastics. According to a recent story in *Business Week*, 8000 members of the National Association of Master Plumbers reported that they were dissatisfied with plastics' performance as substitutes for metals in plumbing, pipes, faucets, etc.—although, they at least were willing to hope that there might be some better and less expensive plumbing fixtures when some of the plastics still on the confidential or restricted list once become available.

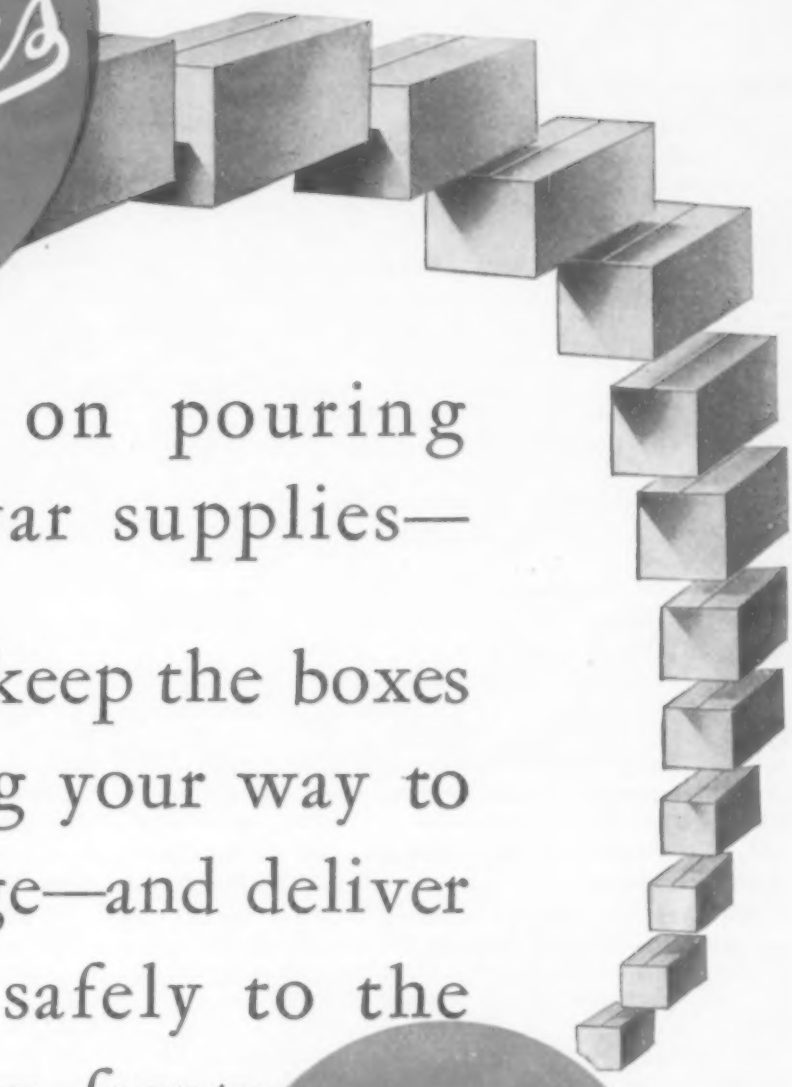
Let the vendor beware!

The truth in the above observations should be acknowledged. In houseware, plastics have been frittered away on thermoplastic sink strainers, measuring spoons, salad sets, kitchen utensils, which the unsuspecting homemaker plunged into hot water with disastrous results. Thermoplastic showerheads and certain plumbing fixtures were never suitable as a vehicle for hot water or for high temperature conditions. Cellulose nitrate buttons and jewelry have always presented a recognizable danger which the less flammable plastics might avoid. Picture frames, toys, compacts, lipsticks, cigarette cases were produced from plastics specified as "anything we can get." Designed without compensation for cold flow, with thin walls, without reinforcements where strains might be expected, they are dampening the feminine appreciation of the beauty of color and finish of plastics. Faithful replicas of metal products have made no allowance for the special properties of plastics which demand and permit new conceptions in design and fabrication.

On the other hand, hardware manufacturers have a healthy respect for plastic tool handles, door knobs, escutcheon plates and numerous other items long accepted as standard accessories. This can be attributed to the fact that the correct material was chosen and that the construction, design and price were right. Thermosetting cosmetic containers have been produced in stock molds as standard items as well as for fine beauty preparations.

There are thousands of other "bread and butter" applications of plastics to be found not only on every type of merchandising counter but also in every industrial and scientific

Gaylord Boxes



Keep on pouring out war supplies—

We'll keep the boxes coming your way to package—and deliver them safely to the fighting fronts.

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CORRUGATED AND SOLID FIBRE BOXES • FOLDING CARTONS •
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category. There is every reason to expect the use of plastics will continue to expand and that many of the spectacular prophesies and promises made for and by the plastics industry will be realized.

However, there is no reason to allow the undertone of dissatisfaction to mount into a crescendo that will sour the song of plastics achievement. Let the industry "face the music" and be frank about its limitations and welcome the partnership of other materials. At the same time a program of sound education should be undertaken that will prevent a recurrence of the ghastly mistakes of the past.

A ten-point program

First: the industry must expose the fallacious misleading theories and unqualified opinions of self-styled "experts." It must point an accusing finger at the Sunday supplement fantasies and refute the exaggerations with proof of actual accomplishment.

Second: the plastics industry should direct attention to reliable channels of information, authoritative literature, responsible publications, manuals and news services, educational motion pictures and exhibits.

Third: it should share its technical knowledge so that those within the industry and the prospective groups who will enlarge its sphere of activity will be capable of sound utilization of new plastics materials, machinery and processes.

Fourth: it should discourage by drastic measures the "chislers" whose exploitation of plastics threaten to malign the entire industry.

Fifth: the plastics industry should be explicit in outlining the extent to which it can provide new and additional opportunities for investment and labor.

Sixth: the industry must prepare for competition by providing mass produced products at costs that will compare favorably with competitive materials.

Seventh: it should follow accepted business practice in basing quotations on accurate uniform standard accounting of expenses and all factors involved.

Eighth: the plastics industry must be resolute in admitting its limitations and be prepared to reject unsuitable projects, for any one or for all plastics.

Ninth: It should encourage and assist in the adoption of standard grades of the common commercial types of plastics, identified by accepted generic or simple chemical names, instead of the perplexing technical tongue twisters.

Finally: the industry must be prepared to undertake an ambitious program of consumer education which will let the buying public know what plastics will and will not do.

A step in the right direction is the new Handbook for Retailers published by the National Retail Dry Goods Ass'n in cooperation with the Society of the Plastics Industry, which is designed to translate the complicated chemical nomenclature into language that will be intelligible to the store buyer and sales person. Similar handbooks for sales personnel have been prepared for their own use by such progressive mail order houses as Sears, Roebuck and Montgomery Ward.

Another project, previously proposed and discussed in MODERN PLASTICS,[1] is Informative Labeling. Such labeling will not only help distinguish actual plastics products from items which do not belong in the plastics family but also help identify the different types of plastics. Labels will explain what a plastic item is made of, how it is made, what it will do, and in addition will instruct the consumer how to care for his purchase, recommend usage so that thermoplastics won't be thrown into hot water, buttons and ornaments sent to the cleaner, or brittle thermosetting ashtrays bounced on a stone floor or walk.

It seems possible that informative labeling may prove to be the answer to many of the ills and abuses which have characterized the plastics industry and it is to be hoped that the industry will not ignore and waste the progress already made toward the adoption of a program of this nature.

As far as this publication is concerned, we are more and more convinced that activity along this line is not only needed, but is an essential project that the entire industry should promote and develop. We have no intention of allowing the subject to languish but are going to investigate it further—thoroughly and constructively. And, from time to time, we intend to report our progress. In addition, we are planning a thorough study of some of the faulty plastic applications. An analysis of the reasons for and behind a failure and constructive suggestions for proper design and use of materials will, we believe, help promote a mature understanding of the plastics potential.

The plastics industry had advanced to the stage where it must take stock of itself and its family and begin to present to the public its own story, directly, simply and honestly.

[1] "Information, Please," *21*, 75 (June 1944).

A steam generator

(*Continued from page 135*) it costs more to heat up a cold mold irrespective of whether the steam is produced by electricity, coal or oil. Consequently the comparisons would still be the same.

In order to check a standard boiler installation against this newer method, it was necessary to estimate the amount of steam that would be used by this press in an hour's time. An inquiry to the F. J. Stokes Machine Co. brought forth the following information: It is normal to figure that a 150-ton single-opening press with one pair of steam plates approximately 24 × 24 × 2 in. in size, operating on a straight-heat cycle (no chill necessary), requires 60 lb. of steam per hour. This company also states that this figure includes a substantial safety factor because actual requirements vary considerably depending upon the number of cycles, the construction of the mold, and many other factors.

Assuming that, on the average, 60 lb. of steam power would be needed per press per hour, the next step was to compute the cost of supplying this power from a central station. Here comparisons were difficult. The only available figure which included such items as maintenance, repairs, wages, etc., came from the Boston Edison Co. which sells steam. It is presumed that this company's price compares favorably with that of steam produced on a molder's premises inasmuch as it has no difficulty in marketing all of its surplus. Again, it should be made clear that this steam price can be considered too low instead of too high if there is any possibility of error apparent. This company stated that while its steam price depends upon a number of factors such as quantity and pressure, it would figure a fair average price to be $1.25 per thousand lb. of steam at 150 lb. gage pressure. At this rate, 60 lb. per hour would cost $7\frac{1}{2}$ cents per hour. This figure appeared to be about right to an executive of a large molding company.

From these figures it is apparent that the new steam generator enjoys a decided advantage in operating cost. The Vaportron Corp. states that a piece of equipment of this type should sell for approximately $200. Adding this low

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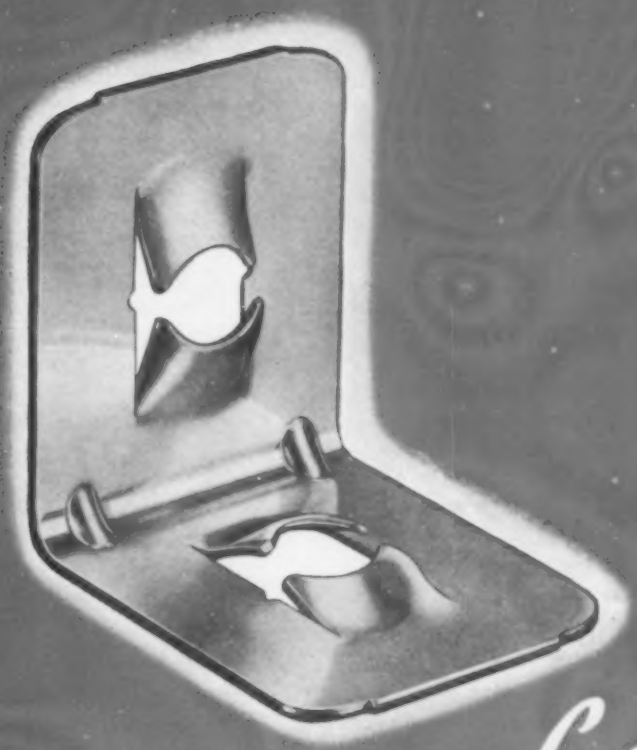

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● If your product requires brackets for assembly, why not use brackets with self-locking nuts *built right in them*? Why fumble around with separate lock washers and threaded nuts and use a wrench besides to keep them from turning? Why handle 9 parts (bracket, 2 screws, 2 lock washers, 2 nuts, screw driver and wrench), when 4 parts will do a better job? (SPEED NUT, 2 screws, and screw driver). Think of the savings in manhours and materials this could mean in *your* plant!

These SPEED NUTS lock with a firm spring tension that permanently prevents vibration loosening. They reduce weight, speed up assembly, and strengthen the structure. And since they are produced on high speed automatic machines, these self-locking brackets are not expensive.

Hundreds of manufacturers have improved both their products and assembly methods by changing over to Tinnerman angle brackets. Write for samples, mentioning part numbers of the type that interests you most.

TINNERMAN PRODUCTS, INC.
2048 Fulton Road, Cleveland 13, Ohio
In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario
In England: Simmonds Aerocessories, Ltd., London

THE BASIC PRINCIPLE
of Spring-Tension Lock is
Embodied in all Speed Nut Designs

Speed Nuts
PATENTED
*Trade Mark Reg. U. S. Pat. Off.
FASTEST THING IN FASTENINGS

initial cost to the low operating cost, it would appear to be to the best interest of all compression molders to investigate this new development thoroughly.

The results given above would seem to indicate that this method of heating a compression mold is convenient as well as economical. Furthermore it is considered a distinct improvement by the molders who have had experience with it. These are the elements of increased efficiency, and taking all these factors in conjunction with the present efforts of electric utility companies to find new markets for their power after the war, it appears likely that individual heating of compression molds by electrically generated steam is the pattern of tomorrow.

Expanded polystyrene

(*Continued from page 109*) terials were placed in water with only sufficient force applied to hold them upright. Each of the samples were 10 in. in length and the indicator shows that the plastic sank only about 1 in. while the cork submerged approximately 3 inches. An equal amount of weight was then added to each sample and they retained approximately the same position in relation to each other. Figure 3 shows the same samples after one week's exposure to the above conditions. The cork has lost more buoyancy than the expanded polystyrene. These results indicate that the plastic has about 30 percent more buoyancy than the cork after one week of submersion in water.

13—*Here equal weight of expanded polystyrene and polystyrene are compared. The difference in volume of the two pieces is approximately 42 times. For illustrative purposes, the increase in volume was only in one direction*

PHOTO, COURTESY DOW CHEMICAL CO.

Despite the fact that, at the present time, Styrofoam is commercially available in only one density, a variety of unusual applications has been found for the product. Many of these applications are based on its extreme lightness and, in particular, its buoyancy. Among those that can be mentioned are military and Naval life rafts, boats and floats. In addition to these, other military applications which are still secret make use of its unusual electrical properties, thermal properties, moisture resistance and buoyancy.

After the present conflict is over and expanded polystyrene becomes available for civilian purposes, it will, without doubt, find many uses in the fields of boating, aviation, refrigeration, decorative window and counter displays, movie sets and even in toys. It is only necessary for the reader to examine the material to envision many places where this expanded plastic may adapt itself to his own interests.

Forming vulcanized fibre

(*Continued from page 125*)

Where a small part that is to be formed requires no soaking in water—eliminating the need for drying under pressure in the die—it can be made in a punch press. The use of such a press reduces forming time to as little as a fraction of a second, producing up to 500 pieces per hour.

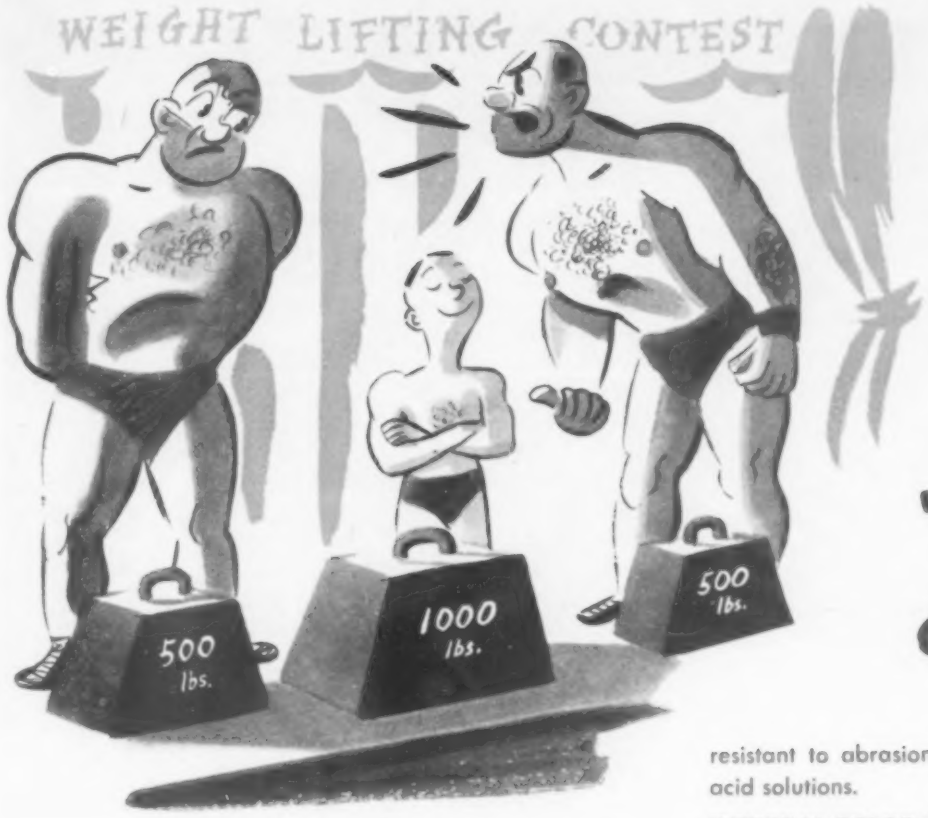
Forming vulcanized fibre with heat

While vulcanized fibre has no thermoplastic properties whatsoever at temperatures below 250° F., it becomes thermoplastic at 325 or 450° F. and can be formed or bent into the more simple shapes. However, the amount of draw or bend that is possible with heat alone is considerably less than that which can be obtained when the fibre is wet. Approximately the same type of parts can be produced in this manner as are obtainable by post-forming laminated phenolics.

Hot metal platens are recommended for hot-forming fibre and the heating interval is quite short. A piece of fibre, $^1/_{16}$ in. thick, placed between hot platens that are maintained at 400° F., will be heated sufficiently in 15 seconds. After heating, the blank is placed in a die of metal, wood or other insulating material, quickly closed, and allowed to cool below 250° F. before removal. Since little distortion is experienced in the hot-forming of simple shapes, the fibre blank usually can be completely fabricated prior to forming.

Fibre can also be swaged by forcing it into die cavities under high pressure. This usually is done dry with the application of some heat. The tremendous pressure forces the fibre to flow, filling the die cavities. The action is similar to that of thermoplastic compounds under pressure in an injection molding machine.

Experience has shown that formed fibre parts maintain stable dimensions when used under normal atmospheric conditions. However, since fibre is pure cellulose it absorbs moisture when exposed to high humidity air. This absorption may be controlled by coating the surface of the fibre part with suitable lacquer. An example of the satisfactory results obtained by this surface lacquering is the vulcanized fibre safety helmets which have been used for years in mines where the humidity runs high and water dripping is common.



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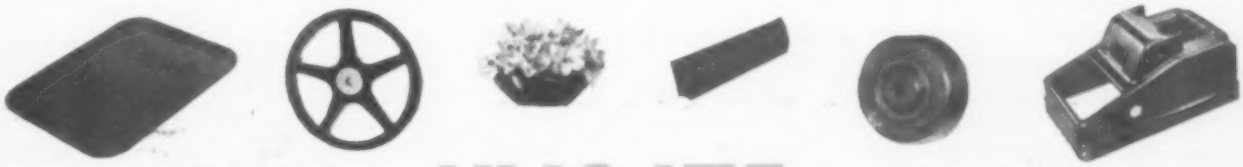

KYS-ITE

The Long-Fibred Wood Pulp Filled Phenolic Resin Plastic Pre-formed Before Curing

Reg. U. S. Pat. Off.

Brake linings for jeeps

(*Continued from page 112*) lining is then extruded as a strip (Fig. 2), automatically cut into 10-ft. lengths and carried by conveyor through a long curing cycle. It is during this latter period that the by-products of the plastic reaction are removed without causing porosity in the strip.

The cured strips are cut into suitable lengths and loaded into specially designed toggle presses mounted on a conveyor belt. These presses are so designed that they pass through the curing oven and load and unload finished and properly shaped brake lining segments in the same operation. Finally the interior and exterior surfaces of the brake segments are ground to exact radii and thickness measurements, and the necessary rivet holes drilled by a multiple-spindle drill press (Fig. 1). Seemingly ready for shipment, the completed brake linings are again passed through the ovens for another long superheated curing cycle before being packed in their cases or installed in waiting jeeps.

Development of these phenolic resin bonded brake linings which are turning in such excellent performance records would seem to promise the postwar motorist greatly increase braking efficiency. Postwar plans of this company include the expansion of development work and production to include brake linings for use on all types of both commercial and passenger vehicles.

Credits—New plastic and brake linings developed and produced by Marshall-Eclipse Div., Bendix Aviation Corp.

Synthetic textiles

(*Continued from page 101*) outside the fibers prove their point by stating that resin coating the surface of the fibers would cause stiffness like a coated fabric. The opposite school of thought, however, says that stiffness results only from a continuous surface coating and that the polymerized resin is deposited in tiny mounds as a contiguous but discontinuous coating. At any rate the treatments are applied under conditions designed to secure maximum penetration of the fiber, and all are agreed that the resin does penetrate the fiber. A very interesting proof of this can be seen in the microscopic slides of fiber cross sections showing that dye does not penetrate the interior of a resin-filled fiber as it penetrates an untreated fiber. Dye permeates the treated fiber very much more slowly, and has a tendency to ring-dye.

The melamine treatments are simply applied on standard mill-finishing equipment, usually a pad mangle. The principle of this mangle is that the fabric passes through a bath and two rollers like a wringer. The fabric must then be dried and cured at temperatures of 280 to 300° F. Curing is a bottleneck in most wool finishing plants as they are not equipped for such high temperatures.

A third resin shrinkage treatment still in the experimental stage uses vinyl-type resins and is applied from a water emulsion. It is said to have an affinity for wool and to be "dyed" onto the fabric. After the fabric passes through the emulsion bath, the solids are precipitated with an acid. Further curing or baking is unnecessary. Though still in the experimental stage, its ease of application makes this treatment very promising. The fact that it needs no curing equipment will undoubtedly be a tremendous asset.

The value of the wool shrinkage treatments for civilian goods—blankets, woolen and worsted fabrics and knitted goods—can scarcely be overestimated when one reflects that they can decrease shrinkage on an ordinary sweater by 75 percent and can, to a large extent, hold the sweater to its initial appearance, avoiding the harsh matted look of used wool that has felted.

Plastics in printing and dyeing

Plastics are the basis of a new coloring process in which the resin acts as a cement, binding on pigments to the fabric. Hence comes its name, resin-bonded pigment dyeing. Its importance in the textile world is great, not only for its present use but for its future import. It is the only method found so far for coloring some of the newer synthetics such as glass fibers. In addition it is a more rapid process than ordinary dyeing, and it can be used to bind on other finishes simultaneously with the pigments. The resin, deposited in tiny islands as a discontinuous coating, effects three changes. First, it binds on coloring; second, it sets the fibers in place permanently—reducing slippage, particularly in synthetic fibers with slippery surfaces; third, it improves the hand of the fabric by the added body which it gives.

Pigment dyeing has had a long and troubled career of trial and error. Pigments have been known and used for coloring textiles since 400 B.C. but, until the process of coating or gluing them on with resins was discovered, there was no means of using them for dyeing so that they would not wash off. Though most dyes are characterized by solubility or partial solubility in aqueous media and by having an affinity for textile fibers, pigments are not soluble in water and they have no affinity for textile fibers. Their application to textiles was, therefore, much more difficult to develop.

The first commercial use of resin-bonded pigments was a vogue, several years ago, for lacquer printing on rayon dress goods. Because of the fine sharp lines which the process gave, attempts were made to adapt it to cotton shirting, but the lacquer gave too harsh a fabric. Within the last decade a process was successfully developed for printing shirtings with pigmented water-in-oil emulsions. Essentially, these emulsions consist of an outer continuous phase made up of an organic solvent solution of synthetic resins in which the pigments are dispersed, and an inner discontinuous phase made up of small globules or droplets of water. The pigment colors are applied on the conventional textile printing machine, after which the fabric is dried and subjected to high temperature to polymerize the resin.

This process produced fine, sharp lines and good wash fastness, and it was widely adopted in the late thirties for printing shirtings. It obviated steaming or soaping, and enabled the immediate detection of defects, since, unlike many dyes, the pigments exhibit their final shade immediately.

Pigment colors were also extensively used before the war for printing cotton dress goods, pajama fabrics and ticking. To a less extent they were used on rayon prints. Some pigments have excellent light fastness and are particularly suitable for printing draperies and curtains. For photographic prints or engravings they are unexcelled because of their fidelity in detail. Pigment colors are, however, subject to crocking or rubbing off—particularly in the dark shades—and this has limited their use.

Shortly before the war, two processes of all-over dyeing with pigmented emulsions were introduced commercially. One was an oil-in-water and the other a water-in-oil type emulsion similar to that used in printing. In the oil-in-water emulsion, pigments are dispersed in the outer continuous phase which consists of resins dissolved in water; the inner discontinuous phase consists of organic solvent in the form of glob-

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ules. Each type of emulsion has its advantages, and each has been extensively employed for dyeing military fabrics and used to a lesser extent for dyeing civilian fabrics. The resins most used for both emulsion processes are ureas, melamines and alkyds, though others can be used.

Printing and dyeing can also be done with dispersions of pigments in aqueous media. For printing, a modified starch is employed as the binding agent and the pigment dispersed in the starch solution. Printing by this method is less fast to washing and crocking than printing by the emulsion method. For dyeing, an alkali-soluble cellulose ether is used as the binding agent, the cellulose ether being dissolved in caustic soda solution and the pigment dispersed in this solution. This process is used chiefly for voiles, marquisettes and tricot nettings, and it has been much used on the Army insect nettings in combination with a fire-retardant finish and a fungicide. It is an inexpensive process with excellent fastness to light, though its wash fastness is inferior to that of the emulsion process.

Though solvents are not popular in finishing plants because of the fire hazard, a fourth process of pigment dyeing is a pigment dispersion in an organic solvent solution of resin. It is used largely for military work, for the pigment-coated flameproof and mildewproof tentage which has already been referred to and for camouflaged burlap and shrimp netting used around permanent gun emplacements. In finishing plants the solvent solution is applied on an ordinary padder which squeezes the liquid out of the fabric after it passes through a bath. In coating plants it is applied usually by knife spreader.

The Quartermaster Corps has used large quantities of both nylon and cotton insect netting. For the nylon netting, pigment dyeing as well as vat and acetate dyes are being used. Most of the cotton netting is being finished by the pigment method using hydroxy cellulose ethers. Pigment-dyed cotton also went into camouflaged fabric for the Corps of Engineers after chemists worked out pigments with an infrared reflectance similar to that of foliage. This camouflage cannot be detected by cameras of enemy observers even when they are equipped with infrared film.

15—*Self-cooling water bags developed for the Army's use in desert or humid jungle areas provide an interesting example of synthetic textiles' contribution to the war effort*

The importance of pigment dyeing for civilian use will lie in the fact that it can be used with many finishes in a time-saving operation. It is compatible with a wide range of treatments, such as creaseproofing, water repellency and washable glazed finishes. It has even been used to bind a non-skid finish onto the deck of landing craft.

For the non-absorbent synthetic yarns, too, it should prove a boon. Glass-fiber cloth is the classical example of a synthetic which cannot be dyed by ordinary means, but some of the newer synthetics—such as the new fiber A—present a similar problem.

Crease-resistant fabrics

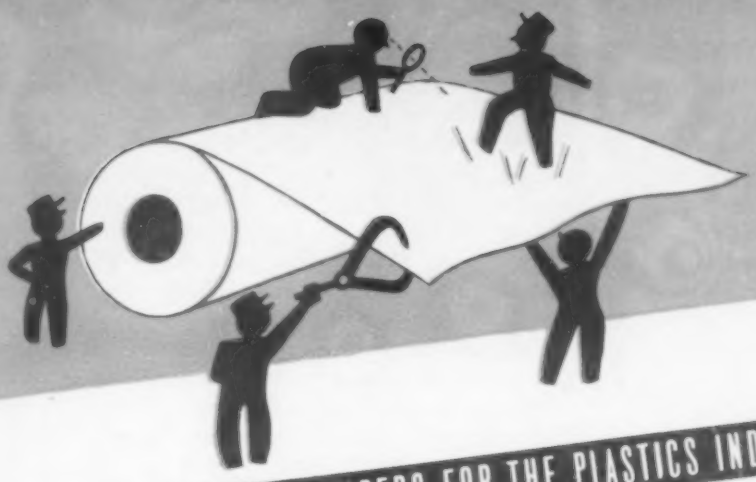
Chronologically, crease- or crush-resistant finishes are the earliest of the resin finishes. Through crease resistance has been generally used in England and in continental Europe for many years, it has not been as much in demand in this country where it was introduced in 1934 by an English company which still holds the patents.[4] In our country its chief use has been on voiles and light-weight cotton and spun rayon dresses, while in Europe it is also used for heavy fabrics such as men's suitings. It was the first successful application of plastics to the modification of textiles. Originally applied only to cotton, it was soon adapted to spun rayon. Now millions of yards of fabrics contain 10 to 15 percent of resin as a creaseproofing agent without causing any change in the appearance of the fabric.

The original process was a fiber impregnation with a water solution of unpolymerized urea formaldehyde. Some of the licensees are now using methylol melamine, but urea is still the resin that is generally used under the patent. Like the other resin finishes it is applied from a bath and squeezed out in a padder, after which it is dried and cured. Curing temperatures of about 300° F. are required, but most of the rayon and cotton finishing plants are better equipped for such temperatures than the wool plants, and its application presents few problems.

As in the theory of the impregnation of the wool fiber, opinion is divided as to whether all of the resin is deposited inside the fiber, or whether some of the resin remains on the surface of the fibers as a discontinuous coating. By some it is said that any excess resin which is deposited on the surface is removed by the squeezing and subsequent washing. Another school of thought holds that, to get complete crease resistance, the fibers must be impregnated and also coated, though not with a continuous film which would seal the pores.

Most of the crease-resistant finishes now go on rayon, to which they add special properties. The great weakness of rayon is its loss of strength when wet, and the creaseproofing increases the wet strength of the fabric, in some cases by as much as 100 percent over the untreated fabric. It increases dry strength of rayon by as much as 50 percent. By setting the fibers permanently in place, it stabilizes both rayon and cotton fabrics, preventing them from shrinking or stretching. Though shrinkage is not entirely eliminated, it is very much reduced, and the fabric is prevented from sagging out of shape. Creaseproofing also prevents slippage—of most im-

[4] Tootle, Broadhurst, Lee Co.



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portance in rayon but also necessary in sheer cotton fabrics. Slippage is the tendency of the fibers to slip over each other when a strain is placed on the fabric, leaving a small vertical rift that looks as if it might have been made by a fingernail. It occurs most often at the seams, where the fabric can be seen pulling away from the thread stitching. Rayon and the synthetic fibers are particularly subject to slippage, and its control is an invaluable asset.

The creaseproofing finish also improves the hand of the fabric—particularly of sleazy fabrics—and it adds greatly to the weight—an asset in some fabrics but not in others. Urea formaldehyde creaseproofing finishes add very much more to the weight than the melamine compounds now being used by some licensees under the patent and being experimented with by the original company.

Though there are many patents for stabilizing and controlling the shrinkage on cotton and rayon fabrics, all creaseproofing, whether with ureas or melamines, automatically gives stabilization and shrinkage control since the stage of shrinkage control is reached with less resin than creaseproofing. More resin must be added for creaseproofing.

Urea formaldehyde is also used for crushproofing velvets under the same patent. Under an earlier and less successful process, formaldehyde alone was used. In velvet, the problem is the crushing down of the pile rather than the creasing of the fabric.

Creaseproofing is, of course, a relative term and does not mean that the fabric is absolutely proof against creasing but only that, like a wool tweed, it has sufficient resilience so that the wrinkles will fall out when it is hung up overnight. Though it is the most used of all the resin finishes, it is surprising that it is not more widely employed in view of the tremendous advantages it gives—particularly to rayon fabrics. The bulk of all the resin used in finishes goes into creaseproofing, and last year approximately 50 million yards were processed.

It is interesting to note the classification of this finish in England where textile mills are under control during the war and are permitted to weave only certain "utility fabrics" specified by the Board of Trade. These fabrics are controlled in price, weave, finish and every detail of construction. In the spun rayon group of twenty-two different weaves, the Board of Trade has specified crease resistance on eighteen of them, suggesting that the process was so essential for the values and wearing qualities it gave rayon that even at added cost it was to be preferred. Some crease-resistant rayon fabrics have been used in the British women's services.

Stabilization, shrinkage and stretch control

There are many patents covering the dimensional stabilization of cotton and rayon. Most of them use urea and, more recently, melamine resins. However, since neither their principle nor their application is in any way different from the crease resistance just discussed, it is not necessary to cover them in detail. Many of them also give a better, fuller hand, but their chief advantage is that they can reduce residual shrinkage to 2 percent on most fabrics. A current problem with these finishes is that urea is said to increase the affinity of the fiber for chlorine, and most laundries continue to use chlorine with some damaging effect on the fiber. This damage can be avoided if the laundries—with only a slight increase in expense—use an agent to counteract the chlorine.

Finishes for modification of hand

Though many of the finishes already discussed modify the hand to some extent, other resin finishes have been developed especially or entirely to produce a modification of hand and appearance. Several resins—polyvinyl acetate, polystyrene and polyvinyl butyral—are used for this purpose, but a notable group are the acrylate resins. Polyacrylic ester resins can be applied to fabrics in the form of aqueous dispersions, a colloidal dispersion which may be hard and tough or soft and pliable. The resins are already polymerized and no curing is necessary; it is only necessary to dry them on dry cans or tenter frames—standard equipment in all finishing plants. This process is said by the material suppliers to be both an impregnation and a coating of the fibers. It protects the fabric and increases its abrasion resistance.

These finishes give various effects ranging from full leathery finishes for spun rayon to soft lustrous calendar finishes and silky finishes for heavy drape. One of the most popular in the group of finishes for modification of hand is the glazed chintz finish. Permanent glazed chintz finishes durable to repeated launderings and shrink-controlled within 2 percent, are based on melamine and urea formaldehyde, and they should have a wide demand for postwar draperies.

Hydroxy cellulose ethers are coming into increasing use as finishing agents for cotton and rayon fabrics. They give a permanent finish (in place of starch) which adds greatly to the appearance and durability, particularly in linen and cotton tablecloths and damasks. But a more unusual development is their experimental use in warp sizing. Warp yarns require reinforcement to withstand the tension to which they are subjected in weaving, and the traditional way of protecting them is by starchy mixtures which have to be washed out during finishes. Cellulose ethers give permanent protection though their application is more difficult.

Resin finishes to create special effects

Resin finishes which might be mentioned under this heading are legion, but there is one of such outstanding significance that it may revolutionize the cotton industry. It is the process for resin-bonded cotton roving.

Leading authorities believe that we utilize not more than 35 percent of the strength of the cotton fiber—probably considerably less than that. Considerable strength is lost through the slippage of the fibers within an individual yarn. To prevent this slipping, yarns have been spun, from time immemorial, with a twist. If there is too much twist, however, strength is again lost through the shearing action of the fibers on each other. In a yarn with optimum twist, the outer fibers have most of the twist and the fibers toward the center have almost no twist at all. Therefore, when the yarn is pulled the outer fibers close on the inner fibers with a tight grasp until the breaking point is reached—the outer fibers taking the strain.

In the ideal yarn, each fiber would have the same twist and bear an equal share of the strain when the yarn is pulled. The fibers should be able to slip into proper position so that not all the strain is on the outside fibers, and *the fibers should then be held in that position*. This is essentially the principle of the resin-bonded cotton roving.

It has long been known that stretching, even when dry, increases the strength of yarn. In 1937 stretching was applied to tire cord after it had been wet and allowed to age. The wetting and aging process softened and swelled the fibers, making them more plastic. Subsequent stretching nearly to the breaking point and drying in this stretched condition produced a cord of very high strength.

Utilizing the same principle of taking the stretch out of cotton yarn to increase its tensile strength, resin bonding materials were applied[5] in solution or emulsion form to the yarn—

[5] U. S. Patent No. 2,220,958.

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stretching it almost to the breaking point while the resins were in a plastic stage and then setting the bonding materials on the fibers. This process increased the tensile strength of cotton yarn 70 to 80 percent so that it compared favorably with linen thread in tensile strength.

This first process was developed for the shoe thread industry. However, its vast possibilities were obvious and it was soon applied to the tire-cord field. As the process left a residual stretch of only 3 percent in the shoe threads, some changes had to be made in processing tire cord which required a residual stretch of 6 to 7 percent. The solution was found in a restretching process, stretching the cord first almost to the breaking point and then rewetting and restretching it to leave a greater amount of elongation the second time. This left the required residual elongation and gave an increase of 50 to 60 percent in tensile strength.

These processes were applied to yarn or cord already twisted. The most recent development is their application to cotton roving (yarn which has not been twisted and stretched). In roving, the individual fibers are not tightly bound. They are free to adjust themselves and, as the fibers are almost parallel, there is no shearing action under strain. The roving is also more uniform than the yarn that is spun from it and very much softer and, therefore, more easily penetrated. Applying the same process to roving, a product of slightly greater tensile strength was obtained than when conventional twisted yarns of the same size were treated and of much greater than the same conventional yarn untreated.

Both thermoplastic and thermosetting resins can be used in this process; as it is very new many resins are being experimented with. In a discussion of these experiments at the October meeting of the A.A.T.C.C.,[6] it was stated that an ester gum combined with a little alkyd resin had been found to be one of the most useful.

Where can you see these remarkable finishes?

At this point we fall back in embarrassment on sturdy bromides: "there is a war on, you know" and "many of them are in an experimental stage." But when due allowance is made for the fact that some finishes are going almost entirely into war products, that some are in an embryonic stage, and that others go chiefly into industrial goods, the fact remains that consumers have not been sufficiently supplied with permanent finishes on their textiles or with sufficient information about the finishes to guide their buying.

Urea formaldehyde is the most widely used of all the resins for finishes (being used for everything from protection against silverfish to creaseproofing) and, from the point of view of the volume of resin consumed, a large amount of urea goes into textile finishing. The War Production Board allocates approximately a million pounds of urea textile products each month (the percentage of resin in each product averaging from 25 to 40 percent, though occasional finishes contain as much as 80 percent). This includes a small amount of urea used in the coating industry. Of the million pounds of urea products allocated, the bulk goes into creaseproofing and crushproofing, which take approximately 75 to 80 percent of the monthly allocation. Printing and dyeing take about 10 percent and stabilization finishes about 10 percent. This breakdown is only an approximate one, taking an average of several months' figures, but these three groups together account for 95 to 98 percent of all the urea textile products used. Finishing uses a very much smaller amount of resin per yard than coating, but the total volume of resin consumed in finishes is greater.

[6] The Treatment of Cotton Roving and Yarns with Bonding Agents.

Despite this seemingly large volume of finishing materials sold, many fabrics and garments are sold without the necessary permanent finishes or with inadequate finishes. This is due in part to the segregated nature of the textile industry to which we referred in the opening paragraphs. The textile finisher does not, as a rule, own the goods he finishes. He works on contract with a converter who owns the goods and bargains for the best price in finishing. Naturally, then, if a finish for improving the hand has not been specified, he does not add to his costs by putting it on. Naturally, too, the converter does not specify a finish for hand if he can sell the goods without the finish. In an industry of such ramifications as the textile industry, it is more difficult to establish consumer demand for minor details than in a well-integrated industry which is immediately sensitive. In the textile world the voice of the consumer must penetrate the labyrinth of chemical salesmen, converters, dyers, finishers and garment manufacturers—each of whom bases his profits on such details as special finishes.

Only insistent demand together with an exacting system of informative labelling and informative advertising will bring the consumer the permanent finish he would like to have on his sport jackets, his upholstery fabrics and draperies.

Acknowledgments

MODERN PLASTICS gratefully acknowledges the assistance of many executives and technicians in the preparation of this article. Thanks are due to Dr. Milton Harris of Milton Harris Associates, Dr. Harley Y. Jennings, assistant director of research, Riverside and Dan River Cotton Mills, and to Dr. D. H. Powers of the Monsanto Chemical Co., and many officials of the Calco Div., American Cyanamid Co., Rohm and Haas Co., The Aridye Corp., and Sylvania Industrial Corp. The technical personnel of the Research and Development Division of the Philadelphia Quartermaster Corps also assisted most generously.

Washington round-up

(*Continued from page 183*) And when they start doing that for one item, they will have the same situation for a dozen or more articles.

Electric iron production

According to a recent announcement of the WPB, the Westinghouse Electric and Manufacturing Co. voluntarily stopped production of electric irons for civilians in its plant at Mansfield, Ohio, on Jan. 8, 1945, in order to transfer employes to critical war work. J. H. Ashbaugh, vice-president of the company, said: "We are voluntarily halting this civilian goods production due to the critical manpower situation in this area. We hope to be able to resume production of electric irons as soon as war conditions and the manpower situation will permit."

In April of 1944, WPB authorized the production of 157,000 electric irons in the Mansfield plant. Of that quantity, less than half had been completed before production was stopped.

Synthetic rubber production

Jesse Jones, former Secretary of Commerce, has announced that the synthetic rubber production of the Rubber Reserve Co. has been approximately 1,000,000 long tons. Of this total, 737,000 tons were manufactured in 1944. Aside from the synthetic rubber turned out by Government plants, private industry produced 26,000 long tons in 1944. Synthetic rubber plants are capable of producing at least 1,000,000 long tons of synthetic

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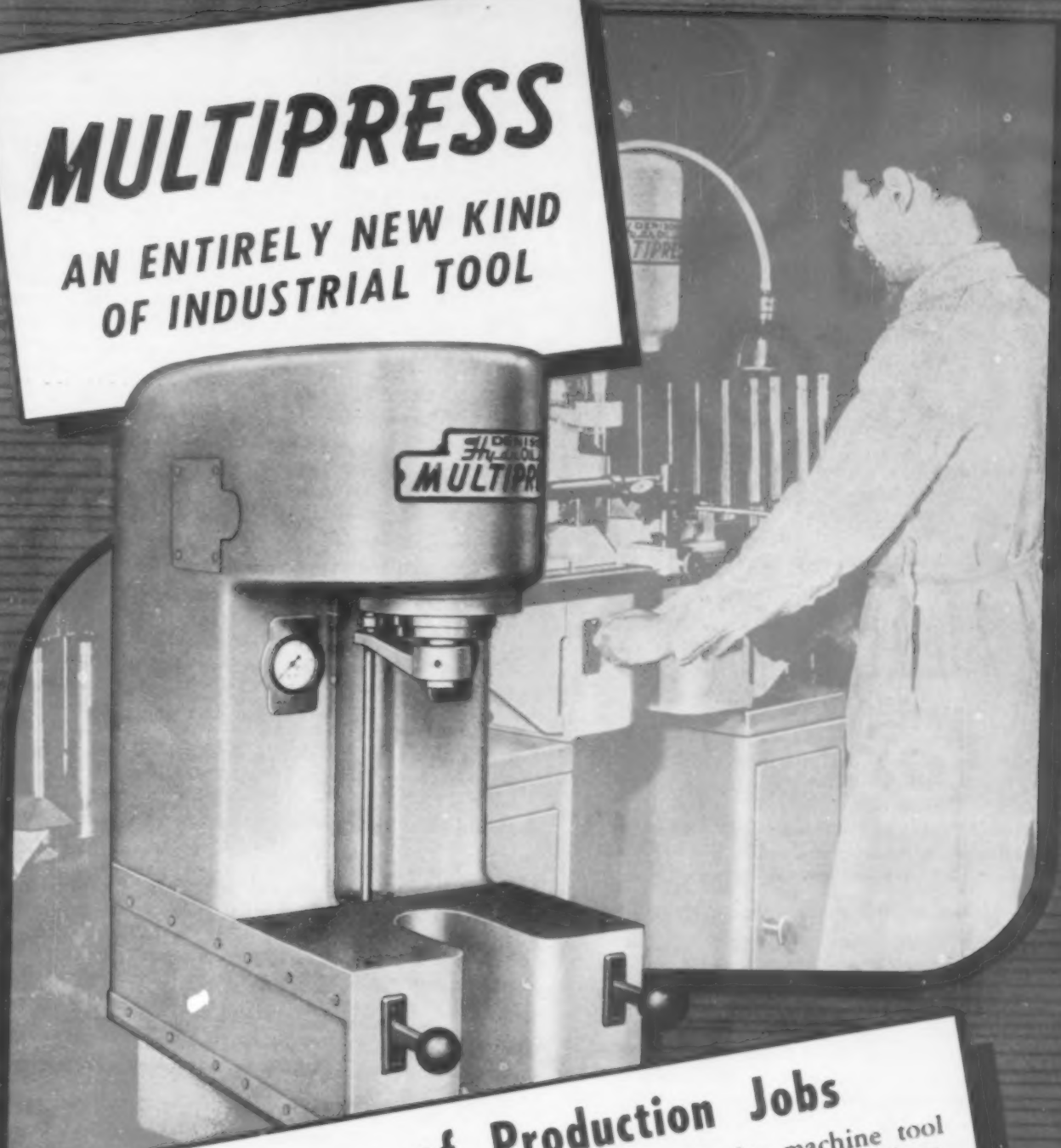

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rubber a year, if necessary. Forty-seven chemical, petroleum, rubber and industrial companies are operating the plants for the Rubber Reserve Co., and something over $700,000,000 has been invested in plants and facilities for the manufacture of synthetic rubber.

Prior to the war, natural rubber cost from 18 to 20 cents a pound. Synthetic rubber is now being produced in some of the plants at less than these figures, and some in the industry feel that it can be produced in competition with natural rubber. The cost for 1944, exclusive of plant amortization, was approximately 33 cents a pound. This was due to the fact that more than 60 percent of the rubber was made from high-priced alcohol instead of petroleum.

Tightened control of price order

On Jan. 6, 1945, the Office of Price Administration announced an amendment designed to tighten control of pricing of synthetic resins and plastic materials and synthetic rubber not marketed during March 1942—the base price date of the regulation covering these commodities. The amendment, which went into effect on Jan. 13, specifically states that prices reported, proposed or established for items not marketed during that period may be reviewed, revised or revoked by OPA at any time.

Previously, the right of the agency to revise such prices during the 20 to 120 days after filing or at any time later than 6 mos. after filing, was not clear. OPA may now act at any time, if necessary, to bring prices for the new items in line with those for similar commodities priced at March 1942 levels under other provisions of the regulation. (Amendment No. 7 to Maximum Price Regulation No. 406—Synthetic Resins and Plastic Materials and Substitute Rubber—effective Jan. 13, 1945.)

Urea and melamine small order cut

Because of heavy military requirements for glycol ethers and urea and melamine aldehyde resins, the WPB on Jan. 6 amended Schedule 34 of Order M-300, the general chemicals allocation order, reducing the small order exemptions for these chemicals. Because of the critical supply of formaldehyde, used in the production of urea and melamine resins, the small order exemption was reduced from 2000 to 550 lb. a month.

Adjustment of electric iron prices

In order to encourage production of low-priced electric irons, the Office of Price Administration announced an adjustment provision under which narrow margin producers may apply for price increases. The action will affect a relatively small number of firms that have been authorized to make a limited number of electric irons to retail for less than 5 dollars. OPA said that the great bulk of the electric iron manufacturers will, as previously announced, market their irons at no change from March 1942 prices, but a few makers of low-priced irons notified OPA that an increase over their March 1942 ceilings would be necessary.

By the order, effective Jan. 12, 1945, any increased maximum price will not exceed an amount equal to the manufacturers' total October 1941 cost to make and sell the article or his October 1941 selling price (where that was lower), plus present increases in manufacturing costs that have resulted from legal changes in material prices and straight time factory wages, plus an amount determined by applying his average percentage profit on net sales in the years 1936–39 to his October 1941 total cost. (Amendment No. 22 to Order No. A-2 under Maximum Price Regulation No. 188—Manufacturers' Maximum Prices for Specified Building Materials and Consumers' Goods Other Than Apparel—effective January 12, 1945.)

Chemical industry expansion

The WPB has issued a report on the chemical industry's production record in 1944 in which it was stated that the American chemical and allied products industry in 1944 achieved the highest production level in history, reaching a record output of $8,300,000,000, or roughly about two and a quarter times what it was in 1939.

Chemicals and allied products in 1943 had a dollar value of $7,500,000,000 while 1942 production was estimated at $6,300,000,000. According to Bureau of Census figures, 1939 production had a value of $3,700,000,000.

Officials describe the chemical situation today as being in "good shape," crediting this largely to the actual construction of new facilities costing $1,500,000,000 since 1939. New facilities are currently being authorized at a rate of $12,000,000 a month, or an estimated $150,000,000 for 1945. The entire expansion program of $1,700,000,000, approved to date, was 88 percent completed at the close of the year, it was disclosed.

Of the total construction approved to date, WPB officials estimate that $500,000,000 will be the cost of chemical plants erected as part of the program for the production of butadiene, styrene, neoprene and catalysts in the synthetic rubber process. Approved construction also includes approximately $350,000,000 for chemical plants to serve the Army Ordnance, while $50,000,000 worth of new plants will produce materials needed by the Chemical Warfare Service. Officials explained that the foregoing figures do not include chemical-consuming plants such as military explosives, chemical warfare gas plants, bomb-filling lines, etc. WPB officials estimate that there are 700,000 workers engaged in the chemical and allied products industries, and that 50,000 more persons are needed to fill the critical gap in the labor force.

Allocation policy for acetate and butyrate

Due to the increased military demand for acetate and butyrate molding powder, WPB found it necessary to change the allocation method for the distribution of the small amount of powder which is left for civilian applications. The purpose of the change in allocation method was to make certain that some of the remaining molding powder was provided for essential civilian end uses which cannot be readily made in other materials.

Beginning with March allocations, therefore, the following policy is effective for Allocations Order M-300-52 for all suppliers' forms WPB-2947:

1. List all military orders as heretofore, i.e., company name, end use, contract number.

2. List all orders, with end use as certified by the molder, which have been accepted by the supplier, for the following categories: a) toothbrushes; b) safety and technical equipment (industrial goggles and respirators); c) corrective optical frames (not sunglasses); d) agricultural supplies; e) plumbing supplies and equipment; f) electrical and industrial equipment; g) communications equipment; h) transportation equipment.

This listing is not necessarily in the order of importance and serves as no guarantee that a molder is going to get his order granted merely because it happens to be listed under one of these categories.

It should be carefully noted that this grouping is intended for suppliers only. The molders are required to furnish a certificate of specific end use to the supplier with each order. The supplier will then group them in the various baskets. For example, if a molder receives an order for float balls and shower curtain rings, he must specify each item when requesting material. WPB retains the right to leave the float balls in the plumbing supplies basket and put the shower curtain rings in the general list which is explained in the following paragraph.

Having an order for an end use which fits into one of the eight civilian groups does not necessarily mean that the order will be allocated in full. It merely means that the order will be given due consideration by the supplier and WPB in the distribution of the material.

3. All civilian items not included in any of the above categories, such as combs, brushes, cosmetic containers, buttons, garment fasteners, hardware, sunglasses, office supplies or equipment, closures, religious goods, housewares, jewelry, toys, and all other items which are not classified above will be entered on the Suppliers' Form WPB-2947 in column (1) for distribution without further authorization pursuant to Paragraph (f) M-300, or column (1a) as "Miscellaneous civilian." (*Please turn to page 214*)

LET US DEMONSTRATE WHAT ELECTRONIC HEATING can do for YOU

PROOF BY TRIAL . . . that's our motto. Before you invest in electronic heating equipment you should be shown how any process requiring heat can be done *better, faster* and *more economically* for you with a Scientific Electric unit.

Our engineers will gladly—*without obligation*—make a study of the heating process under consideration. They will then make recommendations supported by practical demonstrations on the S.E. heater best suited for the job.

This procedure will enable you to figure accurately the economies that will result; also permit you to estimate the time required to pay for the equipment out of resultant savings.

You can submit your heating problems to us with the assurance that absolute secrecy will be observed, if so desired. Investigate the advantages of applying electronic heating in your manufacturing operations NOW. Consult with us at your earliest opportunity.

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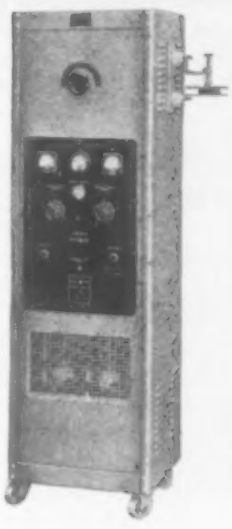
The ABC of Electronic Heating

Manufacturers of
Vacuum Tube and Spark Gap Converters Since 1921



3 KW DIELECTRIC HEATER
Dielectric Heating Units priced from **$1500.**
(3 KW complete)

5 KW INDUCTION HEATER
Induction Heating Units priced from **$1285.**
(for 5 KW complete with 1 work coil)

Scientific Electric

DIVISION OF "S" CORRUGATED QUENCHED GAP COMPANY

19 MONROE ST. **GARFIELD, N. J.**

Scientific Electric Electronic Heaters are made in the following range of power; 3—5—7½—8—10—12½—15—18—25—40—60—80—100—250 KW. — and range of frequency up to 300 Megacycles depending on power required.

The WPB may allocate specifically to the classified civilian end uses or may use Paragraph (f) and add to the supplier's listing the total requested by each classification and allot a specific amount for him to distribute against those classified uses. In other words, WPB retains control of determination of relative essentiality of civilian goods and may be forced to specify that a certain amount of molding powder must be used for some specific items.

Safeguard against fires

(*Continued from page 127*) instruments. Special methods of machining had also to be worked out because of the material's extreme toughness. At the same time, because of the strength of the material, it was possible to reduce the thickness of the panel as compared with the old-type board.

The white glass-fiber cloth that was originally used with the melamine resin produced pure white panel boards. This proved somewhat of a problem to the Navy because of the danger of glare and the difficulty encountered in keeping the boards clean. This objection has been taken care of by heat-treating the cloth before it is impregnated with the resin. The heat-treatment gives the cloth the same brown color as that of the finished board and aids in securing maximum adhesion between the cloth and the resin.

According to a directive from the Navy Department, Bureau of Ships and Bureau of Ordnance, issued December 28, 1944, "It is intended that an orderly change over be made as the brown GMG becomes available. Existing stocks of white GMG may be utilized where it is not practicable to change to brown GMG. Navy type brown GMG may be obtained from the following laminators, among others: General Electric Co., Lynn, Mass.; Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; Formica Insulation Co., Cincinnati, Ohio; Panelyte Division, St. Regis Paper Co., Trenton, N. J.; National Vulcanized Fibre Co., Wilmington, Del.; The Richardson Co., Melrose Park, Chicago, Ill.; Taylor Fibre Co., Norristown, Pa.; Continental Diamond Fibre Co., Newark, Del."

Credits—Products discussed in this article: Material: Textolite Fiberglas filler for panel board. Developed by Plastics Divs., General Electric Co.

News of the industry

(*Continued from page 190*)

★ A FACTORY FOR THE DESIGN AND MANUFACTURE of electrical heating units for all industrial purposes has been opened by Glenn Electric Heater Co., 239–41 Canal St., New York, N. Y.

★ TAYLOR INSTRUMENT COMPANIES, ROCHESTER, N. Y., has appointed Frank Ward as assistant industrial sales manager. Mr. Ward has been divisional sales manager in charge of products used in the plastics industry.

★ D. C. GREENE HAS BEEN NAMED DISTRICT MANager for Haskelite Manufacturing Corp. in the New York area.

★ HARDINGE SALES CO., 269 LAFAYETTE ST., NEW York City, branch of Hardinge Brothers, Inc., Elmira, N. Y., has become a factory branch and will continue operations as such under the management of Frank Suess.

★ CHARLES DAVIES, FORMER PRESIDENT OF DAVIES Air Filter Corp., has entered the field of industrial designing and product engineering. His office is located at 11 West 42nd St., New York City.

★ ANNOUNCEMENT IS MADE OF THE RETIREMENT of Dr. R. C. Benner, Director of Research, Carborundum Co., Niagara Falls, N. Y. Dr. Benner will enter the consulting research field.

★ AN IMPORTANT PROBLEM CONFRONTING THE synthetic rubber industry is that of processing synthetics to reproduce the characteristics and properties of hard and semi-hard rubber stocks as produced from natural rubber. Durez Plastics & Chemicals, Inc., N. Tonawanda, N. Y., has evolved a method of processing most synthetic rubber with a phenolic resin, resulting in the development of excellent hard and semi-hard rubber stocks. Heretofore confined to use with buna s and Buna N, the material is known to be compatible with neoprene and also with natural rubber. The resin, which is thermosetting and is compatible with the synthetic rubber, also reinforces rubber, producing stocks of high tensile strength, a high degree of hardness, good elongation and low-temperature flexibility.

★ THE CHICAGO TECHNICAL SOCIETIES COUNCIL has been formed as a coordinating body through which independent engineering, technical and scientific groups may effect a greater unity of purpose. Officers include: T. S. McEwan, American Society of Mechanical Engineers, chairman; B. E. Schaar, American Chemical Society, vice-chairman; K. H. Hobbie, American Society for Metals, corresponding secretary; P. S. Smith, Institute of Radio Engineers, recording secretary; and G. P. Halliwell, American Institute of Mining and Metallurgical Engineers, treasurer.

★ THE CHICAGO OFFICE OF CELLULOSE PRODUCTS Div., Hercules Powder Co., Inc., has been established as a regular branch office under the supervision of Fred K. Shankweiler. Minnesota, Wisconsin, Illinois, Indiana, Kentucky and Missouri are included in the territory served by this office.

★ EFFECTIVE JANUARY 1945, THE NAME OF MINNEapolis Plastic Co. has been changed to Minneapolis Plastic Molders, Incorporated.

★ ROXALIN FLEXIBLE FINISHES INC., ELIZABETH, N. J., announces the addition to its staff of Edmund H. Schwencke as Director of Plastic Research.

★ TECKNA PLASTIC CO., 223-01 NORTHERN BLVD., Bayside, L. I., plastics fabricators and product engineers, has changed its name to Teckna Company.

★ IN RECOGNITION OF LEADERSHIP IN RUBBER research for four decades and for achievements under his direction in the development and production of synthetic rubber, John W. Thomas, chairman of the Firestone Tire & Rubber Co., has been awarded the Gold Medal of the American Institute of Chemists, one of the chemical world's highest honors. The medal will be formerly presented to Mr. Thomas on May 11 at Columbus, Ohio, during the twenty-third annual meeting of the Institute.

★ A SYNTHETIC RUBBER LATEX, DEVELOPED BY United States Rubber Co. and in production at the Government's synthetic latex plant at Naugatuck, Conn., is a modification of the butadiene-styrene type of synthetic rubber. In addition to having greater uniformity and more easy handling and shipping, the latex mixes well with other ingredients and is easily compounded for uniform viscosity and other desired properties. These advantages are claimed to give the material superior properties in saturating paper and fabric for shoe parts and other artificial leathers; backing of pile fabrics for upholstery and carpet manufacturing; binding vegetable fibres and animal hair for the cushioning of combat tanks, parachute seats and backs and upholstery; solutioning or dipping of tire cord with synthetic rubber latex.

★ UNITED ENGINEERING & FOUNDRY CO., PITTSburgh, Pa., has acquired Adamson Machine Co., Akron, Ohio. Known as Adamson United the new company will be under the supervision of F. L. Dawes, president, Andrew Hale, vice-president, and George Lang, secretary-treasurer, and will specialize in the manufacture of basic machinery for the plastic, rubber and plywood industries.

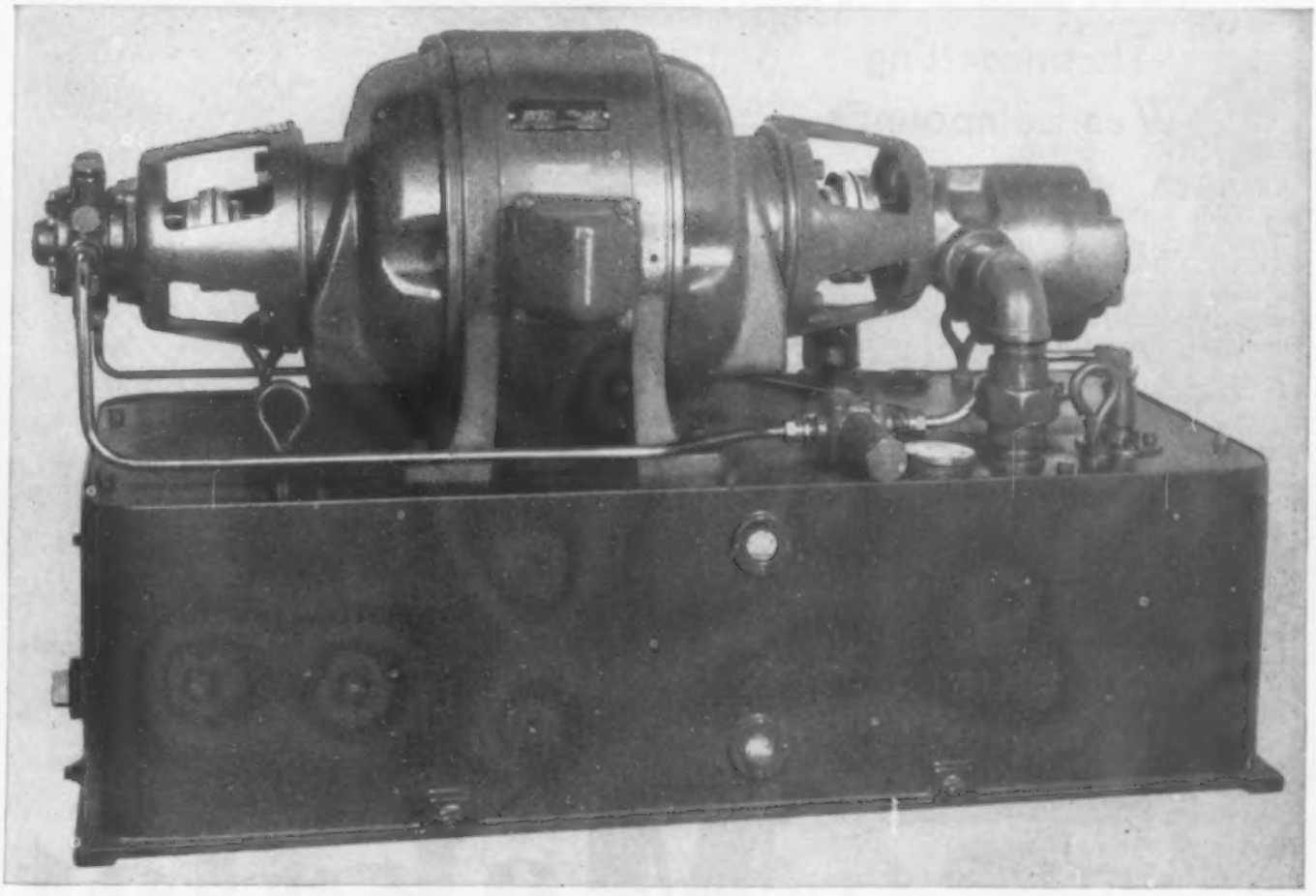
HYCON

Announcing Hi-Lo Hydraulic Power Units

Packaged Units for Fast Prefill
with 3000 p. s. i. Closing and Holding Pressure

Using 10 GPM and 20 GPM Low Pressure Pumps
in Combination with ¾ GPM and 1½ GPM Pumps at 3000 p. s. i.

Units Complete with Pumps on Double End Motor . . . Unloading and Relief Valves
and Micronic Filter . . . All Mounted on 40 Gal. Water Cooled Reservoir



Specifications and Engineering Data on Request

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THE NEW YORK AIR BRAKE COMPANY

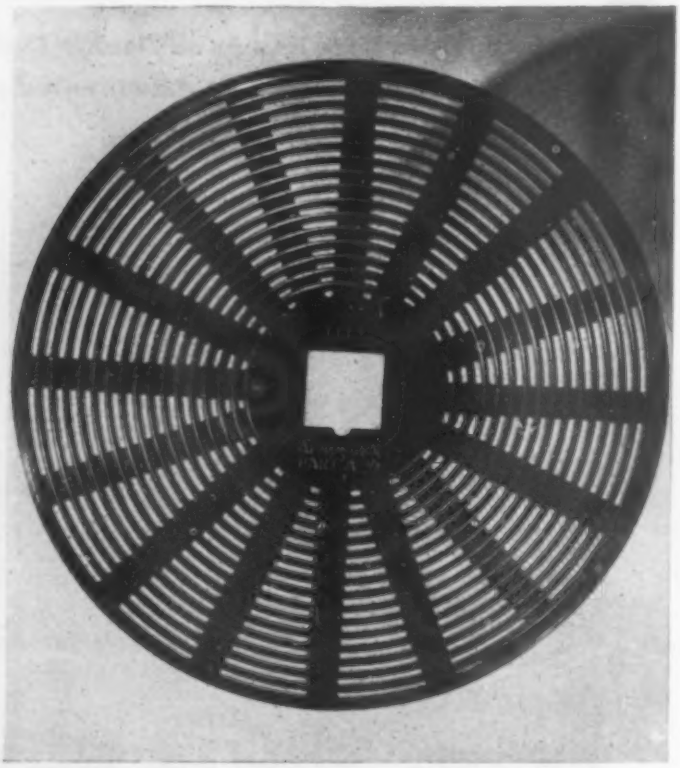
Hydraulic Division

420 LEXINGTON AVENUE, NEW YORK 17, N. Y. • FACTORIES: WATERTOWN, N. Y.

Shortages in critical materials?

Use MAKALOT K.E.M.

Makalot developed K.E.M. to keep our customers molding even under priorities and allocation restrictions. On the left is pictured one of the Toilet Ball floats molded of Makalot K.E.M. Here is a typical example of how K.E.M. molding compounds helped in the continued production of essential civilian products. This valve float ball molded of K.E.M. by Taylor Manufacturing Co. of Milwaukee relieves demands on the critical Phenol and Formaldehyde chemicals, as well as the previously used material, brass. Cafeteria Trays, the beautiful Chesterfield Display Trays, Thermos bottle tops, bottle and jar closures, stove handles, knobs, cup holders, etc., are but a few of the articles molded of MAKALOT K.E.M. The demand for this material is so great we can not promise to fill all orders—but we'll do the best we can. Remember MAKALOT—The Independent Producer of Superior Plastics.



MAKALOT

Thermosetting War Compounds

The Tech-Art Plastics Corp. of Long Island City, New York, well-known for their skill in both design and molding of intricate Plastic products, selected MAKALOT Phenolic Impact material #1804 for the Aeroflex Reel featured on the right. Note the free flowing, the accurate dimensional tolerances and the fine finish. Other outstanding MAKALOT Phenolics are:

Makalot #93-C—CFI-10; Fabric filled super-impact.
Makalot #1040—MFE. The #1 Low Loss material with superior molding characteristics.
Makalot #1163—CFG. General Purpose—unsurpassed in molding and final quality.
Makalot #1912—Exceptionally long flow for transfer.
Makalot #1941—Non-bleeding closure material, with Brilliant finish, fast cure, improved stripping and unscrewing properties.
Makalot #7580—Underwriter's Heater plug material. Excellent flow.
Makalot #2962—Supreme for the past 7 years for satisfactory mold shrinkage. NEVER CRACKS around inserts. Supplied for Compression, Transfer and Jet Molding.
Makalot #1155—Used on the Bomb Boosters—general purpose—fast cure.

Domestic Representatives

CENTRAL STATES
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PACIFIC NORTHWEST
Northwest Plastics Industries
415 4th and Cherry Bldg.
Seattle 4, Washington

921 Terminal Sales Building
Portland, Oregon

PHENOLIC IMPREGNATING RESINS · MOLDING COMPOUNDS · FABRIC & PAPER IMPREGNATING RESINS · UREA RESINS & ADHESIVES · PHENOLIC LACQUERS · VARNISHES

"KEEP 'EM MOLDING"

Makalot

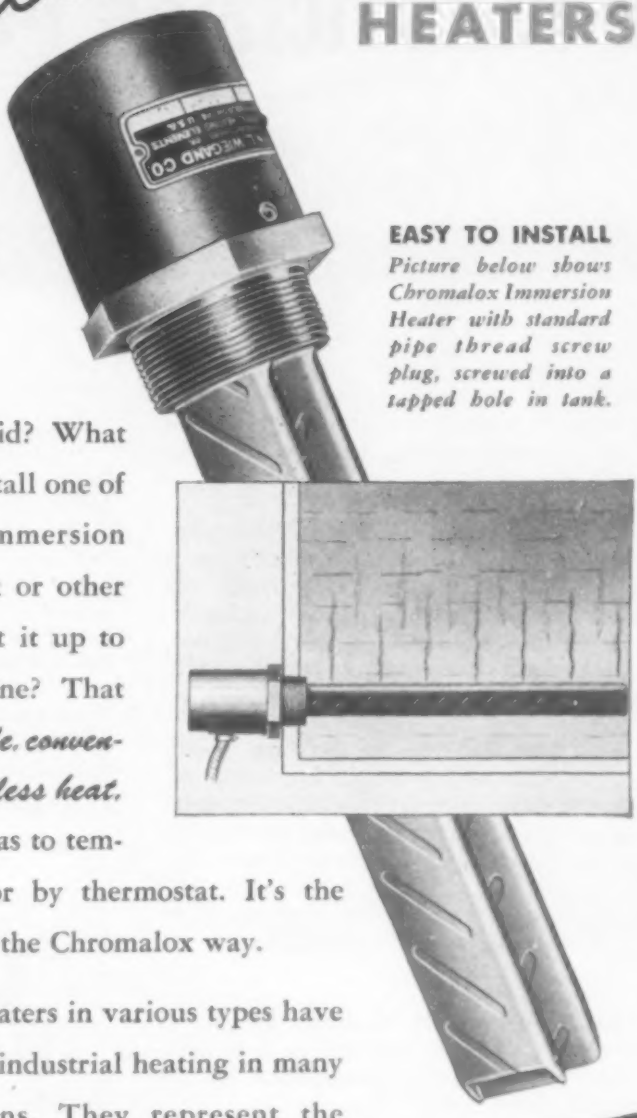
CORPORATION

PLASTICS

262 Washington St., Boston, Mass.

The Independent Producer of Superior Plastics

HEAT OIL, WATER, SOLUTIONS and OTHER LIQUIDS *with* CHROMALOX *Electric* IMMERSION HEATERS



Here is a typical Chromalox Immersion Heater—Type M—available in ratings from 500 to 18,000 watts for water, from 1000 to 15,000 watts for oil or paraffin. It is only one of many Chromalox Electric Heaters for heating liquids.

EASY TO INSTALL
Picture below shows Chromalox Immersion Heater with standard pipe thread screw plug, screwed into a tapped hole in tank.

Want to heat a liquid? What easier way than to install one of these Chromalox Immersion Heaters into the tank or other container and connect it up to the nearest power line? That way you get *quick, safe, convenient, fumeless, flameless heat,* accurately controlled as to temperature, manually or by thermostat. It's the *modern* way to heat—the Chromalox way.

Chromalox electric heaters in various types have taken the grief out of industrial heating in many thousand applications. They represent the industrial heat of *tomorrow,* ready *today* for your needs.

CHROMALOX
ELECTRIC HEAT AT ITS BEST

Some of the most widely used CHROMALOX ELECTRIC HEATERS

STRIP HEATERS for heating flat surfaces or for air heating. Many lengths and capacities.

RING HEATERS to heat circular areas Sizes to 11" in diameter

CARTRIDGE HEATERS for heating dies, platens, molds, process machinery. Applied by inserting into drilled holes.

IMMERSION HEATERS— wide variety for heating water, oil, wax, asphalt, tar and other liquids.

FINSTRIP HEATERS — curved or straight For heating air in ducts or in front of blowers.

FOR MORE "KNOW HOW" ON CHROMALOX HEAT

Call in your local Chromalox Application Engineer. We will connect you. Write for catalog 42 and literature.

EDWIN L. WIEGAND CO.
7503 THOMAS BLVD.
PITTSBURGH 8, PA.

HARDESTY DIBUTYL SEBACATE

means

HIGHEST PLASTICIZING POWER

The main purpose of a plasticizer is to impart flexibility to plastic materials and elastomers. In this property, Hardesty Chemical Dibutyl Sebacate is one of the most efficient plasticizers known. This is strikingly shown in the following table giving the properties of test strips of Vinylite VYNW containing three different plasticizers. The basic formulation used in making these strips consisted of 100 parts of Vinylite VYNW, 55 parts of plasticizer, 2 parts of calcium stearate, and 0.75 part of stearic acid. This mixture was milled on a two-roll mill with roll temperature of 300–310°F., and then molded for ten minutes at 300°F. and chilled under pressure.

These properties show the outstanding plasticizing power of Hardesty Chemical Dibutyl Sebacate. This plasticizing power is retained at extremely low temperatures, as shown by the cold cracking tests in the table below.

Hardesty Chemical Company Dibutyl Sebacate is used as a plasticizer for the vinyl copolymers, polyvinyl chloride, polyvinyl butyral, nitrocellulose, cellulose acetobutyrate, acrylic resins and synthetic rubbers.

In addition to its high plasticizing power and low temperature flexibility, Dibutyl Sebacate is also characterized by its high solvency for various elastomers. It is extremely resistant to yellowing on long exposure to light, tasteless and has no residual odor.

A letter to Hardesty Chemical Company will bring a sample and further information by return mail.

Plasticizer	Modulus at 100% Elongation	Tensile at Break	Elongation	Set	Shore Hardness	Cold Cracking Temperature
Dibutyl Sebacate	584 p.s.i.	2220 p.s.i.	405%	50%	62	Below — 80°F
Dioctyl Phthalate	1075 p.s.i.	2795 p.s.i.	365%	39%	79	—45°F.
Tricreyl Phosphate	1780 p.s.i.	3150 p.s.i.	285%	27%	85	0°F.

Properties of Dibutyl Sebacate

Purity	98.5% Minimum
Specific Gravity	0.935 20/20°C.
Acidity as Sebacic	0.3% Maximum
Ash	0.001% Maximum
Iron	0.3 ppm Maximum
Butanol	0.1% Maximum
Flash Point	380°F
Boiling Point	344°C 760 mm.
	175–180°C @ 3 mm.
Water Solubility	Less than 1% @ 25°C
Freezing Point	11°F
Dielectric Constant	3.6
Power factor—60 cycles	6

HARCHEM

PLASTICIZERS

Alkyl Roleates

Dibutyl Sebacate

Sebacic Acid

Capryl Alcohol

HARDESTY CHEMICAL COMPANY, INC., 41 EAST FORTY-SECOND STREET, NEW YORK 17, N.Y.

BALDWIN SOUTHWARK

HIGH-PRODUCTION PRESSES

SIDE SLAB PRESS FOR HARD RUBBER MOLDING

Baldwin presses confine heat within molds and steam plates, assure positive guiding and have greater rigidity. Users collect dividends in lower maintenance. Baldwin Southwark Division. The Baldwin Locomotive Works, Philadelphia, Pa., U. S. A. Offices: Philadelphia, New York, Chicago, Washington, Boston, Cleveland, St. Louis, San Francisco, Houston.

BALDWIN PRODUCTS FOR THE PLASTICS MOLDING FIELD

Rubber Shears...Vertical and Horizontal Vulcanizers...Sole and Heel Presses...Steam Platen Presses...Belt Presses...Rolled Steel Steam Platens for Presses

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BALDWIN

SOUTHWARK

HYDRAULIC PRESSES

We Have Something Worth Telling Too!

You may not get quite as much of a kick out of it as the lady in the picture, but we know you will consider it important.

It's this: You now have the opportunity to contact our representative in New York, Philadelphia or New England whenever you run into a problem in connection with

MOLDED PLASTICS

They'll give you the information you want, or if it is something with which they are not familiar, their close contact with us makes it easy for them to get the answer.

ESTABLISHED 1919 — TRADE MARK

Put it up to

KUHN & JACOB MOLDING & TOOL CO.

1200 SOUTHARD STREET, TRENTON 8, N. J.
TELEPHONE TRENTON 5391

Plastic Molding

Sales Representatives: NEW YORK—S. C. Ullman, 55 W. 42nd St. PHILADELPHIA—Towle & Son Company, 18 W. Chelten Ave. Bldg.
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EXTRUDED THERMO PLASTICS

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Methyl Methacrylate
"Lucite"

Made to Order ONLY
No Stock Items
Details, Quotations — *Promptly*

Ameroid
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IN RODS, DISCS, SHEETS AND PUNCHED FLAT SHAPES for fabricators. Non-inflammable, readily turned and machined. Wide color range.

AMERICAN PLASTICS CORP.
225 West 34th St. New York City 1

Make Plans Now . . .
for the coming **PLASTIC ERA**

Consult ROGAN

Here at Rogan, seasoned engineers are ready and willing to assist you in determining your post-war *Plastic* requirements.

Whether your peacetime products are to include electronic equipment, electrical appliances, stoves or what have you, the Rogan Organization will gladly provide cost-free advice on all phases of plastic production.

Send Us Your Specifications Today!

ROGAN BROTHERS
Compression Molders and Branders of Plastics
2005 So. Michigan Avenue Chicago, Illinois

NORTON LABORATORIES (INCORPORATED)
CUSTOM MOULDERS OF SYNTHETIC PLASTICS
BAKELITE and DUREZ
LOCKPORT, N.Y.

NORLOC NOVELTIES

ALL AGREEMENTS ARE CONTINGENT UPON STRIKES, FIRES, ACCIDENTS OR CAUSES BEYOND OUR CONTROL.
CONTRACTS WITH AGENTS NOT VALID UNTIL APPROVED BY AN OFFICER

March, 1945

Dear Plastics User:

The Chinese have a custom of serving the sweet at the beginning of a meal and the soup last, and that is about the way we feel these days. A few months ago we were talking a lot about reconversion and postwar planning and making new things out of plastics for consumers.

But, here we are deeply immersed in war production and we don't think that now is the time to discuss civilian requirements. We are pulling in our belts, both literally and figuratively, in every phase of life, and we don't think that the plastics industry should be exempt.

We have always thought it a bit silly to talk too much about our contributions to the war. After all, plastics won't win this war -- not even in the most essential uses. When we achieve victory, it will belong, as far as we are concerned, to the Army and Navy and everyone who fought on our side.

The reason we are advertising at all is to remind you that we are very much in the plastics industry, that we are working top speed to turn out everything we can for the war -- and that the experience and know-how we have added during the past years, based on our pre-war record of successful molding, will mean bigger and better plastics from Norton when the restrictions are over.

See us now or then.

Cordially yours.

WALTER J. LEYDEN
Factory Superintendent

WE BUY, SELL, PROCESS

PLASTICS SCRAP

ACETATE · BUTYRATE · VINYLS · POLYSTYRENE · ACRYLICS

H. MUEHLSTEIN & Co. INC.

122 EAST 42nd STREET, NEW YORK 17, N. Y.

LOS ANGELES: 1431 E. 16 St. - MEMPHIS: 46 W. Virginia Ave. - CHICAGO: 327 So. La Salle St. - AKRON: 250 Jewett St. - BOSTON: 31 St. James Ave.

MOLDS

INJECTION

Submit your present day problems to our experienced engineering staff. You will find an alert, progressive organization equipped to handle your most intricate mold problems.

We are now designing and building difficult automatic molds for many of the leading molders. Why not let us solve your problems? Our molds are tested before shipping, on our new 16 oz. Lester injection molding machine.

1911 • 1945

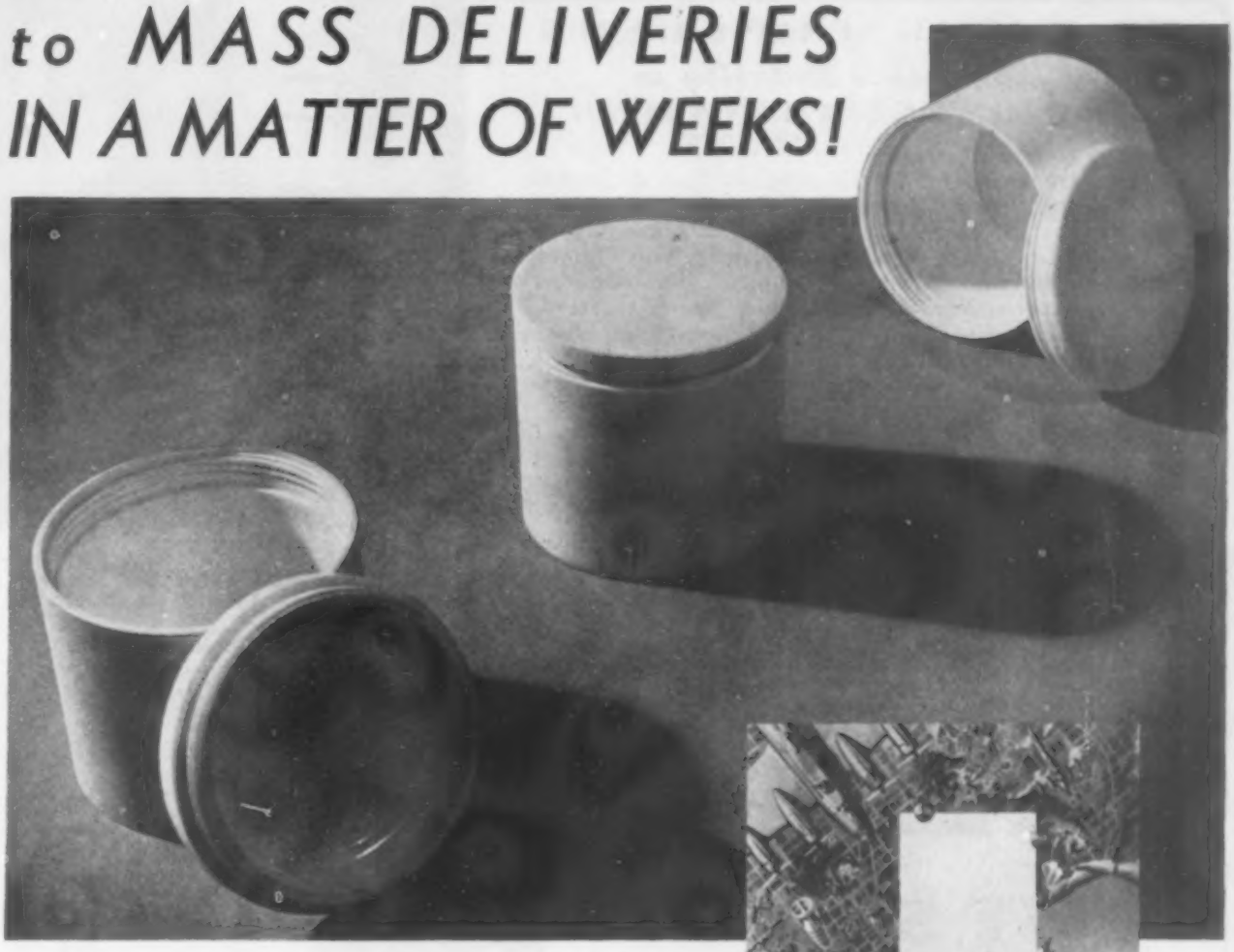
STANDARD TOOL CO.
75 WATER STREET
LEOMINSTER, MASS.

Consider our more than twenty-five years of plastic experience at your complete disposal to aid you in your search for new ideas in plastic mold and tool design.

While we cannot accept new work at present we can help you lay the groundwork for your future in plastics. Telephone Ea. 3881 or write us at the address shown below.

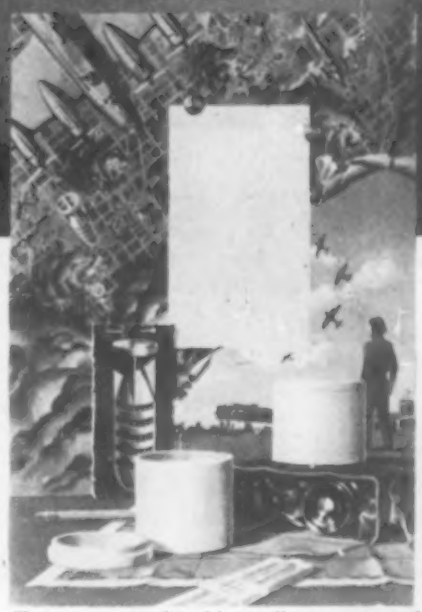
LAWRENCE H. COOK, INC.
MANUFACTURERS OF PLASTIC MOLDS & TOOLS
65 MASSASOIT AVE., EAST PROVIDENCE 14, R. I.

From a "NEW PRODUCTION PROBLEM" to MASS DELIVERIES IN A MATTER OF WEEKS!



The Teckna Company, in less than six weeks time, designed, built and put into operation special threading and forming machinery for inside and outside threading of Catalin Bomb "Cups" for the Chemical Warfare Service.

This production line problem requiring close-precision operation, at top speed, was mastered by Teckna engineers—far in advance of any mass production method, to our knowledge, as yet conceived.



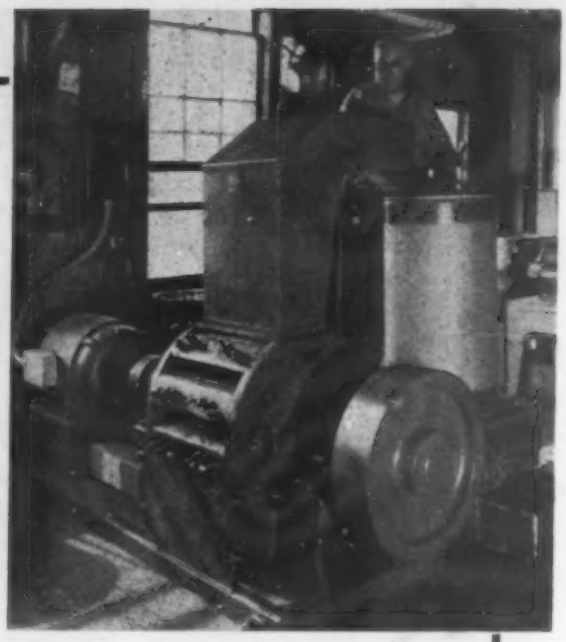
You may remember this excellent montage of the Catalin Bomb "Cups." It appeared in the full color advertisement of the Catalin Corporation, page 3, February Issue, Modern Plastics.

The above case-study defines a problem in which technical ingenuity and quality controlled production were effectively combined to quicken deliveries to the war department. Your particular problem of fabrication of any type plastic, G.M.G., Turned Rods, etc., may be equally uncharted, equally "different." Teckna Company is ready to serve you . . . . let us know your problem or write for special booklet outlining the scope of Teckna's specialized service—be it one piece or a million or more.

TECKNA COMPANY . . . *Fabricators of Plastics*

223-01 Northern Boulevard, Bayside, L. I., New York

THE LEADING SCRAP GRINDER *of the Plastics Industry in* COMMONWEALTH PLASTICS COMPANY PLANT



Photograph shows installation of Ball & Jewell machine in scrap grinding department of Commonwealth Plastics Company, Leominster, Mass. Note the specially designed baffled hopper. The Cutter shown in this photograph is: Model #2. This concern also operates several No. ½ Ball & Jewell Cutters.

These machines have extra heavy castings, solid tool-steel knives, outboard SKF bearings sealed against dust, 3 interchangeable screens each, with more available for different sized granulations.

Ball & Jewell scrap grinders have saved tons of strategic plastics during the war and are proved economically to pay for themselves through the materials they save for reuse.

Inquire about FREE catalog of 13 models

BALL *and* JEWELL 20 Franklin Street Brooklyn, N. Y.

or get in touch with nearest representative

CHICAGO: Neff, Kohlbusch & Bissell. DETROIT: J. C. Austerberry's Sons. LOS ANGELES: Moore Machinery Co. LOS ANGELES & SAN FRANCISCO: Machinery Sales Co. NEW ENGLAND: Standard Tool Co., Leominster, Mass. ATLANTA, GA.: George L. Berry. ST. LOUIS: Larrimore Sales Co. SEATTLE 4, WASHINGTON: Olympic Supply Co. KANSAS CITY, KANS.: Fluid Air Engineering Co.
LONDON, ENGLAND: Blackfriar's Engineering Co., Ltd.
AUSTRALIA, and NEW ZEALAND: Scott & Holladay, Pty. Ltd., SYDNEY
CANADIAN AGENT: Williams & Wilson, Ltd., Toronto & Montreal, Canada

This is #3 in a series of advertisements showing typical Ball & Jewell scrap grinder installations in the plastics industry.

DON'T SPECIFY *"Any Old Reducing Valve"*

Too many buyers of reducing valves, unfortunately, are like that. They think reducing valves are all alike. But that is not true.

For instance if the pressure to be reduced is high—up to and including 6000 lb. per sq. in., we usually suggest the valve shown here, our

ATLAS Type "E"
High Pressure Reducing Valves

It will not only do your reducing job for you but will do it WELL—*without shock*—and it will handle water, air, or oil. That's why most of the leading plastics plants of today are users of this outstanding valve.

Why Is It Outstanding. We can't give all of the answers here, but, briefly this valve has a body that is made of forged steel. Internal metal parts are entirely of stainless steel. A formed packing of special material superior to leather is used which is immune to all fluids commonly used in hydraulic machinery. The pressure on the seat is balanced by a piston with the result that variations in high initial pressure have little effect on the reduced pressure.

Ask for complete information.

For other ATLAS plastics plant products see the partial list in our ad in the January issue of MODERN PLASTICS

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE
277 South Street, Newark 5, N. J.
Representatives in principal Cities

New Dillon-Beck booklet containing unusual case histories showing how a complete molding service efficiently produced many items valuable to the war effort.

You'll find these industrial news-stories interesting and informative. Write today for your free copy!

DILLON-BECK MANUFACTURING COMPANY
103 MONTGOMERY AVE., IRVINGTON, N. J.
ENGINEERS · DESIGNERS · MOLDERS

RELEASE

FIGHTER PILOTS ARE SITTING PRETTY

TEAR DROP DESIGNED FOR PERFECT STREAM-LINING!

A FULL-VISION, PERFECT VISION MUSTANG!

COCKPIT ENCLOSURE CONTOUR-BLOWN WITHOUT MOLDS

BY

STACK Plastics

5835 W. Washington Blvd., Culver City, California

BUY BONDS

Still

ANOTHER STEP OF PERFECTION IN PLASTICS BY STACK

...CREATORS OF "PLASTACK"

Careful attention to detail by a staff of competent craftsmen makes that EXTRA difference in an ACCURATE compression of transfer mold job . . . and is the reason why leading manufacturers prefer ACCURATE facilities when specific specifications, absolute precision and production costs are important! Make ACCURATE your inquiry headquarters for tough problems NOW . . . NO OBLIGATION!
ACCURATE MOLDING CORPORATION
132 NASSAU STREET BROOKLYN, N. Y.

THE NEEDLE MODEL FOR PREFORMS

Manufacturers of thermoplastics find the CAMBRIDGE Needle Pyrometer a most convenient instrument for the determination of internal temperatures of preforms. It provides the means for adjusting the time cycle of the preheater and checking the uniformity of heating throughout a single preform. This instrument is accurate, quick-acting, rugged and easy to use. Combination models available for taking surface temperatures of rolls and molds and for insertion into preforms.

BUY WAR BONDS

Combination and single purpose instruments

Cambridge Instrument Co., Inc.
3732 Grand Central Terminal,
New York 17, N.Y.

CAMBRIDGE
Mold • Roll • Needle
PYROMETERS

Bulletin 194-S gives details of these instruments. They help save money and make better plastics.

TIME
The great teacher

● It is probably truer in plastics than in any other industry that there is no substitute for experience. We have been molding plastics for 25 years—through the greatest period of change and expansion. Let our background serve you as it is serving many of America's leading industries.

KENILWORTH
PLASTICS MOLDING COMPANY
Division of Eureka Button Co. (Est. 1885)
KENILWORTH, NEW JERSEY

Are your products *bearing fruit* IN THE PACIFIC AREA?

Retail sales in the Hawaiian Islands last year totaled $333,566,551. Conservative observers agree that not only will Hawaii's buying power continue to increase, but Honolulu will become the focal point of a vast Pacific trade reaching out into the Orient itself.

Looking at this great market in the Pacific, from any angle, it is evident that fertile fields exist for intelligent exploitation of all lines of merchandise.

But this is not a remote control market . . . Because of its multi-blooded population, this market will respond only when handled sympathetically.

We have the answer in our organization, for we are a strong local outlet that understands the peoples, the Islands, and the potentialities.

Our postwar plans include the establishment of five offices, with an adequate number of representatives, to serve the entire Pacific area.

We shall appreciate an opportunity to assist you in merchandising your products in the Central Pacific area NOW . . . and in the postwar Far East.

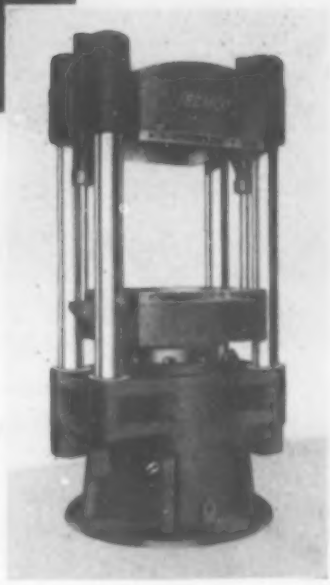
Many Pacific races are represented on our sales and technical staffs. Even now, we are preparing for the day when the end of the war will open the entire Pacific to those who can visualize its possibilities.

R.A. HOWE & CO. DISTRIBUTORS AND REPRESENTATIVES *Hawaii*

816 Fort Street • Honolulu, Hawaii • U. S. A.

PLASTICS
PROCESSING MACHINERY

LABORATORY **mill**



press

EEMCO PRESSES are also built with

- *self contained pumping units*
- *automatic or manual controls*
- *push back cylinders*

For small production runs and laboratory use the EEMCO Laboratory Mill is modern, stream-lined and sturdy.

EEMCO hydraulic presses are built for heavy duty and long life. Ask for Bulletins.

* * *

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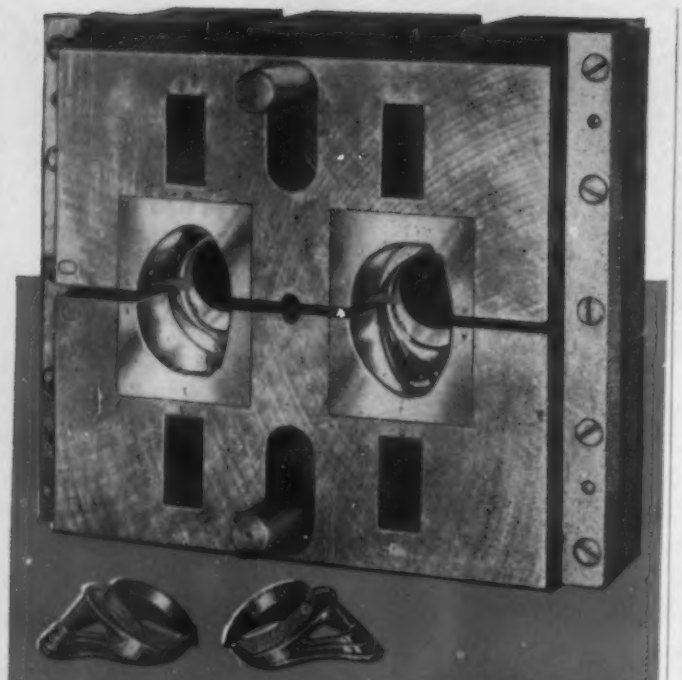
DUGAN & CAMPBELL
907 Akron Savings & Loan Bldg.
AKRON, OHIO.

EASTERN
H. E. STONE SUPPLY CO.
OAKLYN, N. J.

MIDWEST
HERRON & MEYER OF CHICAGO
38 South Dearborn Street
CHICAGO 3, ILL.

EEMCO
ERIE ENGINE & MFG. CO.

953 EAST 12th ST., ERIE, PENNA.



AUBURN MOLDS
Mean a Better Molding Job

When you choose Auburn as your custom molder, Auburn's engineers will construct a mold that will take full advantage of all the inherent characteristics of the plastics materials used . . . a mold that will mean uninterrupted, economical production of your plastics part.

This mold-making ability is the result of Auburn's 68 years molding experience . . . years in which Auburn's skill and reputation have grown steadily until, today, the Auburn mold mark is virtually a guarantee of a perfect molded part.

•

For small parts molded automatically at low cost, write: Woodruff Company Division, Auburn Button Works, Auburn, New York.

MOLD MARK

AUBURN ENGINEERED PLASTICS

All Types of Molding Complete Mold Shop

Extruded Tubes and Shapes

AUBURN BUTTON WORKS

INCORPORATED

MOLDERS SINCE 1876 AUBURN, NEW YORK

MOLDED PLASTICS
FOR WAR-TIME AND PEACE-TIME PRODUCTS

IF you have a plastic problem we invite you to take advantage of our complete facilities—Engineering and Drafting—Machine Shop—Molding dies and Molding—every operation from the drafting board to the finished molded products.

We specialize in Compression and Transfer molding of Thermosetting plastics—Mechanical rubber products to specification—and Laminated materials.

Your inquiry will be treated in strict confidence —and without obligation, of course.

TAYLOR MANUFACTURING CO.

3084 WEST MEINECKE AVE. • MILWAUKEE 10, WIS.

EXPERIENCED FABRICATORS
of all Plastics

This company offers widest experience and facilities in fabricating rigid and flexible plastic sheeting, rods, tubes, film and resin coated fabrics. We manufacture all shapes and sizes of rigid sheet containers, heat sealed and stitched bags, covers and envelopes of vinyl and butyl, film, also wearing apparel, household articles, sporting goods and novelties.

Our war production includes waterproof machine gun covers, nitrate handles for explosives, insulation caps for electrical equipment, fuse covers for shells, soldiers' eye shields, transparent envelopes.

NATIONAL TRANSPARENT PLASTICS CO.

NATIONAL TRANSPARENT BOX CO.

1897 Columbus Avenue, Springfield 3, Mass. Tel. 44979

NEW YORK OFFICE—507 Fifth Avenue. Tel. VA 6-2550

INVESTIGATE NEW SURFACE DECORATION FOR PLASTICS!

Supplants old methods!

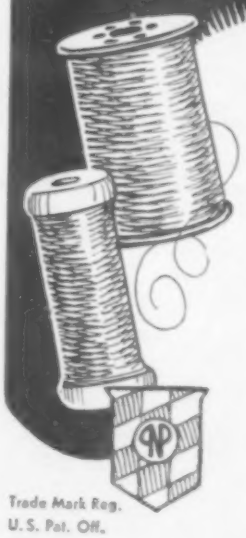
Permanent, integral! Already in use by hundreds of firms in plastics field. Creative Printmakers new surface decoration process applies all colors to all plastics. Shape and size of molded or fabricated object is no limitation. All decorations applied permanently, bonded chemically with the piece. Used on lipsticks, packages, closures, dials, name plates, advertising premiums and many other items. Guaranteed not to scratch, wash or rub off. Weather resistant. Write for prices and information.

Creative **PRINTMAKERS GROUP**

14 WEST 17th STREET • NEW YORK, N.Y. • Chelsea 3-6803

Surface Decorators for the Plastics Industry

SARAN by NATIONAL



FOR BRAIDED WIRE AND CABLE COVERS

Developed in smaller diameters for this purpose, SARAN monofilament possesses properties unknown in any other type of material used heretofore and which greatly improve the characteristics of braided wire for any purpose.

A booklet describing actual tests made with SARAN, and samples, will be sent on request.

Trade Mark Reg. U. S. Pat. Off.

NATIONAL PLASTIC PRODUCTS Company

ODENTON, MARYLAND

The Inside Story

The inner secrets of men and metals are easily penetrated by the X-ray.

It requires no X-ray to see the intricate mechanism of your product when viewed as a TRANSPARENT PLASTICS MODEL.

Such models tell their story without words, saving explanation and discussion, and are now being used by representative companies in practically every branch of manufacturing.

All work is done to precise specifications.

INJECTION • COMPRESSION • TRANSFER MOLDS

STRICKER BRUNHUBER CO.

Mechanical Developers

19 WEST 24th ST. NEW YORK 10, N. Y.

WAtkins 9-0191

THERMOPLASTIC Scrap

BOUGHT — SOLD or RECLAIMED for You!

ACTIVE IN THE PLASTIC FIELD for 22 YEARS

A complete converting service!
It will pay you to investigate our facilities for reworking your scrap.

CELLULOSE ACETATE — CELLULOSE BUTYRATE
STYRENE VINYL AND ACRYLIC RESINS

GP PLASTIC MATERIALS

A Dependable Source of Supply for re-worked Cellulose Acetate and Cellulose Butyrate molding powders

GERING PRODUCTS INC.

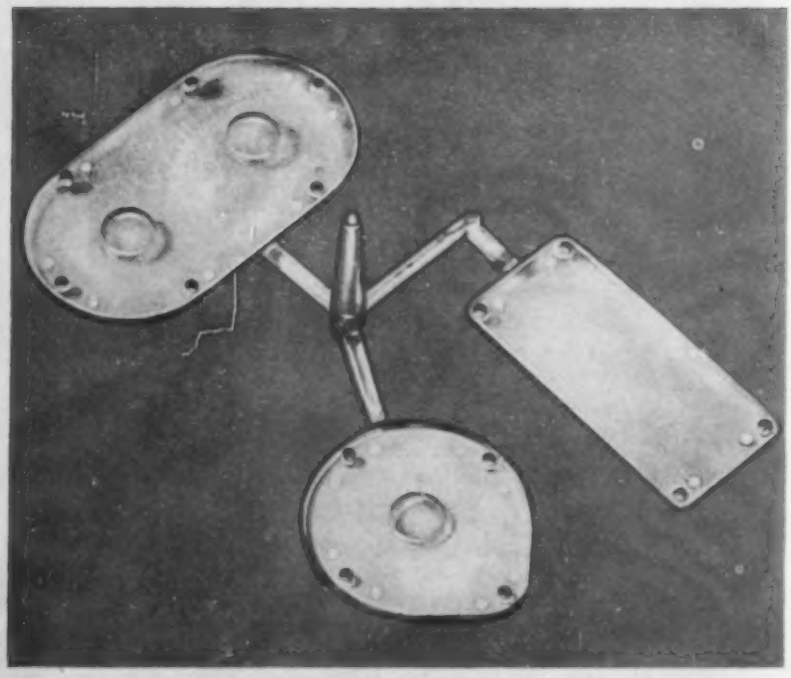
North Seventh St. & Monroe Ave., KENILWORTH, N. J. Chicago Office: 622 W. Monroe St.

LOOKING AT PLASTICS *from a variety of viewpoints*

Each plastic problem presents a series of viewpoints . . . the manufacturers', the molders', the dealers' and the consumers'.

Here — at Ideal — our engineers are trained to look at each piece from those 4 viewpoints. That's why manufacturers rely on us for "more than just a good molding job." That's why we have been called upon by the military for a wide range of plastic items.

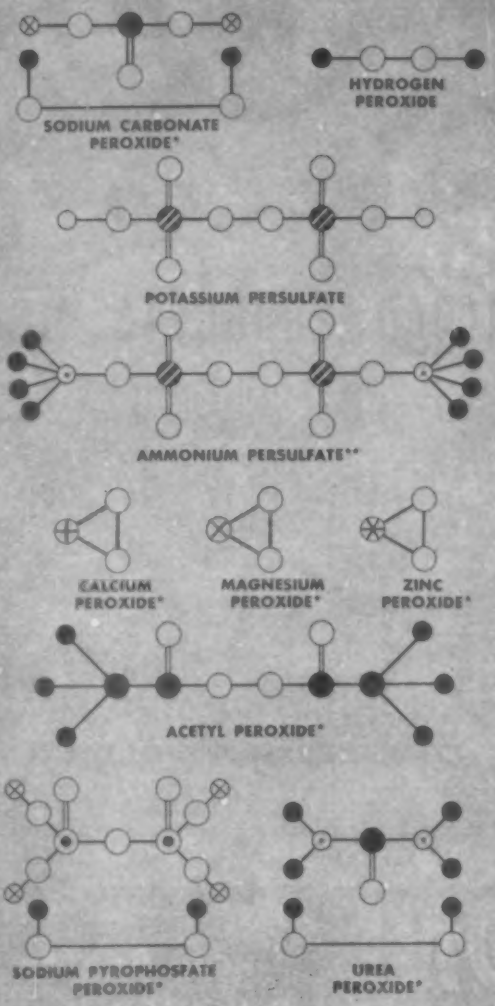
Ideal A SYMBOL OF FINEST CRAFTSMANSHIP IN PLASTICS



IDEAL PLASTICS CORPORATION

A DIVISION OF IDEAL NOVELTY & TOY CO., INC.
23-10 43rd AVE., LONG ISLAND CITY, N. Y.

ACTIVE OXYGEN IS ON ACTIVE DUTY



BECCO Peroxides and Percompounds, both organic and inorganic, have been used throughout industry for many years. Most of our products have gone to war. Some of them are, at present, available in limited quantities while others are obtainable in research samples only. We welcome inquiries in connection with any of them and will be glad to answer your questions as to uses, availability and deliveries.

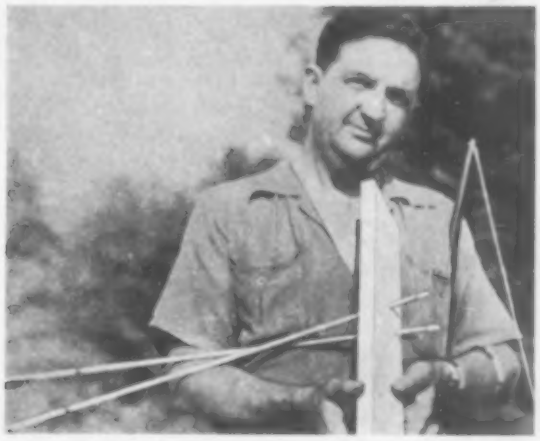
*Available in research quantities only at present.
**Will be available after the war.

BUFFALO ELECTRO-CHEMICAL COMPANY, INC.

BECCO

BECCO
SALES CORPORATION
SALES AGENTS BUFFALO 7, N. Y.

"PLASTICALLY SPEAKING!"



TOUGH!

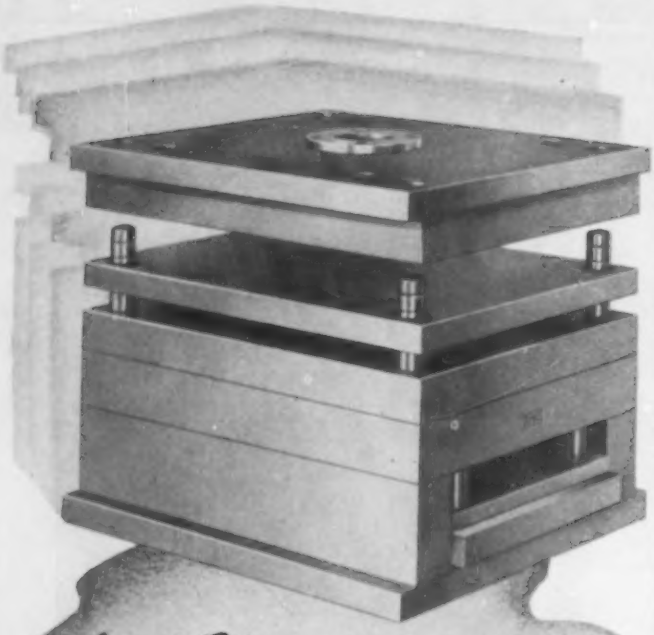
The toughness of plastics is proven by this photo, showing two arrows, tipped with Tenite plastic points, which have pierced a one inch board. More than a million plastic pointed arrows attest their suitability.

INJECTION MOLDING
MINCOR
YOUR PLASTICS DEPARTMENT

TENITE I • TENITE II • VINYLITE • LUCITE
POLYSTYRENE • LUMARITH • PLEXIGLAS

★

MINNESOTA PLASTICS CORPORATION
366 WACOUTA, SAINT PAUL 1, MINNESOTA



And Now..

STRIPPER PLATE MOLD BASES are STANDARD with DME

FOUR new DME stripper plate mold bases —available previously only on special order—are now standard DME items and carried *in stock ready for immediate shipment*. They can now be had in DME standard mold base sizes 2, 3, 4, and 5—ranging from 9" x 12" to 12" x 23½"—and in five or six plate series, as desired.

With greater production facilities at DME, the greatly expanded line of standard mold bases and parts, and the addition of this new series of stripper plate mold bases . . . DME now is prepared as never before to adequately service the nation's mold makers in their every mold base requirement.

We'll gladly send you details of DME's new stripper plate mold bases, with sizes and full specifications.

DME NEWS will be mailed you monthly upon your request.

DME

DETROIT MOLD ENGINEERING COMPANY

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MOLDED PRODUCTS, INC.

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L. S. HOUSE

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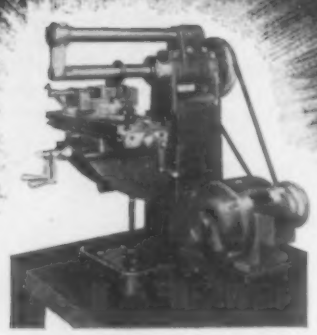
INJECTION AND COMPRESSION MOLDING

ONE BENCH MACHINE FOR BOTH HORIZONTAL and VERTICAL Milling



benchmaster mill with horizontal spindle and overarm

FOR PRECISION TOOL WORK OR HIGH-SPEED PRODUCTION

benchmaster — offers a bench milling machine easily convertible from a conventional horizontal to a vertical miller by simply interchanging the spindle attachments.

ACCURATE • VERSATILE • LOW PRICED

SPECIFICATIONS: Table size—6" x 14"—Three Tee slots ⅜", 2" center • Longitudinal travel 8½" • Traverse travel 5½" • Vertical travel 8½" on vertical mill—9½" horizontal mill • Height 28" • Weight (less motor) 215 lbs. • Requires ½ h.p. motor • Spindle speeds (standard 1725 rpm motor) 450-850-1400-2100 rpm.

benchmaster tools manufacturing company

2952 w. pico, los angeles 6, cal.

Announcement

A. BAMBERGER

announces the removal of their factory and office

FROM

109 SO. FIFTH ST., BROOKLYN, N. Y.

TO

44 HEWES ST., BROOKLYN 11, N. Y.

TEL. EVERGREEN 7-3887

★ ★ ★ ★ ★

AMERICAN MOLDING POWDER & CHEMICAL CORP.

announces the removal of their factory

TO

67 N. NINTH ST., BROOKLYN, N. Y.

AND THEIR OFFICE TO 44 HEWES ST., BROOKLYN 11, N. Y.

TEL. EVERGREEN 7-3887

Stamp NAMES • DESIGNS TRADEMARKS

in Gold, Silver, Colors on Plastic Products

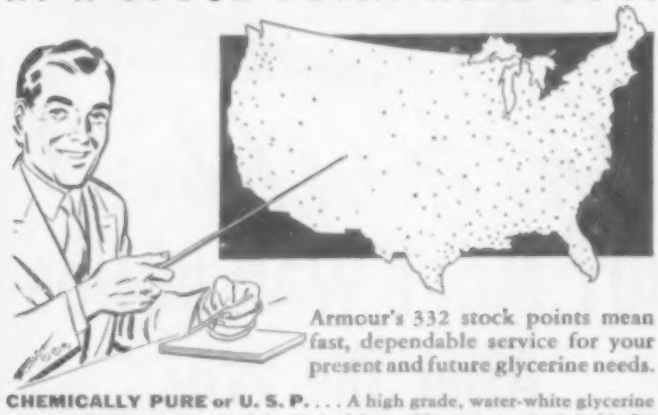
Precision stampings—positive, clean-cut, enduring—can now be done with ordinary girl operators at production speeds up to 1,000 pieces per hour. Write for catalogue, or submit your stamping problems.

Kingsley GOLD STAMPING MACHINE CO.

★ HOLLYWOOD, CALIFORNIA ★

GLYCERINE

QUICKLY AVAILABLE AT A STOCK POINT NEAR YOU!



Armour's 332 stock points mean fast, dependable service for your present and future glycerine needs.

CHEMICALLY PURE or U. S. P. . . . A high grade, water-white glycerine meeting the requirements of the United States Pharmacopoeia. Suitable for use in foods, pharmaceuticals, cosmetics or for any purpose where the highest quality is demanded. It has a specific gravity of 1.249— 25°C./25°C.

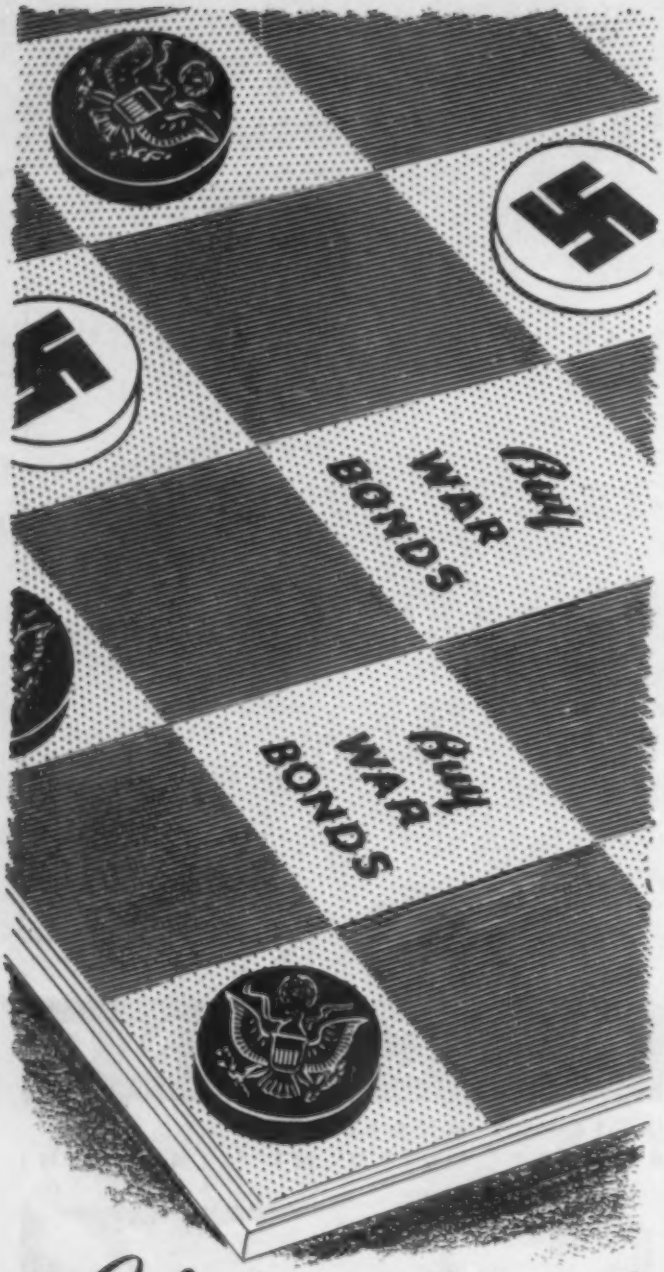
HIGH GRAVITY. . . A pale yellow glycerine for industrial purposes with a specific gravity of 1.262— 15.5°C./15.5°C.

DYNAMITE . . . A yellow glycerine made especially for the explosives trade. It has a specific gravity of 1.262— 15.5°C./15.5°C.

YELLOW DISTILLED . . . A yellow glycerine for industrial purposes with a specific gravity of 1.259— 15.5°C./15.5°C.

ARMOUR AND COMPANY

1355 WEST 31ST STREET - CHICAGO 9, ILLINOIS



It's Your Move!

BUY MORE WAR BONDS

After the War

"Call on Connecticut"

Custom CONNECTICUT Plastics Molders

CONNECTICUT PLASTIC PRODUCTS CO.

70 WEST LIBERTY STREET — WATERBURY, CONNECTICUT

Remove Moisture from PLASTICS

Quickly and Cheaply with

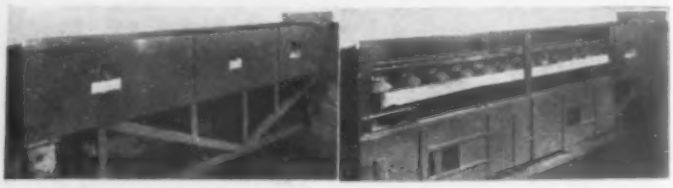
NALCO *Infra-Red* LAMPS

Do you know . . . all of the advantages of Infra-Red Ray Drying with Nalco Dritherm Carbon Filament Lamps?

Use Nalco Ditherm Lamps for efficient results . . . available in Inside-Silvered (self-reflecting) or clear glass types.

Learn all of the advantages of the Infra-Red process for plastic dehydration.

Write for your free copy of "Drying Problems Made Easy" today.



Exterior of Infra-Red Conveyor Belt Tunnel for removing moisture from plastic material prior to molding.

Sides dropped to show arrangement of Infra-Red light bank and materials passing under light conveyor belt.

North American Electric Lamp Co.

1012 Tyler Street St. Louis 6, Missouri

NALCO

PRESSED FOR TIME

Speed . . . without sacrifice of accuracy! That's the modern need in plastic molding. We'd like to tell you how hobbed cavity molding gives you that happy combination.

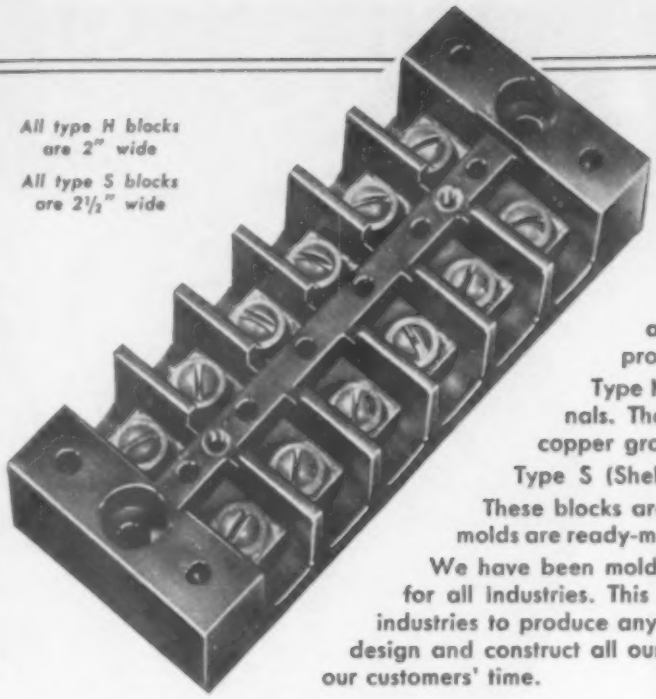
Write for our comprehensive booklet on Die-Hobbing.

HOBBED CAVITY MOLDING

NEWARK DIE COMPANY, Inc.

20-24 SCOTT ST. NEWARK, N. J.

Telephone — MARKET 2-3772, 2-3773



All type H blocks are 2" wide

All type S blocks are 2½" wide

STOCK MOLD TERMINAL BLOCKS

Standardized, stock-mold terminal blocks to serve all war industries quickly and efficiently are in steady production at Insulation Manufacturing Company's plant.

Type H (Bakelite) comes in four sizes: 4, 6, 8, and 12 terminals. The 6 terminal block is illustrated. It is available with copper grounding strip, plastic covers and white marking strip.

Type S (Shellac) comes in three sizes: 4, 8, 12 terminals only.

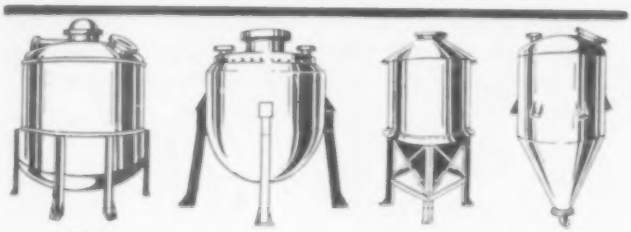
These blocks are standard circuit connectors in many industries. The molds are ready-made and can be put on presses to deliver any quantity.

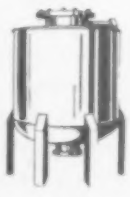
We have been molding plastics for more than 50 years to specifications for all industries. This custom molding service is available to all essential industries to produce any number of plastic parts in all shapes and sizes. We design and construct all our own tools and molds to insure quality and to save our customers' time.

Insulation Manufacturing Co.

CUSTOM MOLDERS OF PLASTICS FOR INDUSTRY

11 NEW YORK AVENUE • BROOKLYN, N. Y.





Special

VATS, KETTLES, STORAGE BINS and TANKS, DIGESTERS, and PRESSURE VESSELS

Made to A.S.M.E. Standards in aluminum, stainless and other alloy steels in any practicable thickness, shape, and capacity. Estimates gladly furnished. Send us blueprints or specifications of your requirements.

The STACEY BROS. Gas Construction Co.

One of the Dresser Industries

5535 Vine Street
Cincinnati 16, Ohio

PROCESSING EQUIPMENT

Stacey Brothers

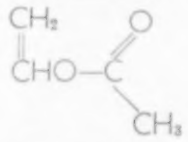
ENGINEERS · FABRICATORS · RECOGNIZED EXPERIENCE & FACILITIES

Now Available Without Restrictions

UNPOLYMERIZED

VINYL ACETATE

(STABILIZED)



Purity 99.5% Boiling Range 71.8° to 73°C.

Vinyl Acetate can be polymerized to form resins with exceptional bonding qualities for wood, glass, metal and fibre

Containers:—

410 lb. drums; 62,500 lb. tank cars

For further information write to:

NIACET

CHEMICALS CORPORATION

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ENDURANCE

The "life expectancy" built into a mechanical product largely determines its designation as "low" or "high" quality.

Frequently the FASTENING POINT in the assembled piece is the spot where vibration, torsion, flexion, corrosion, electrolysis, fatigue, etc., first reveals weakness. Here, then, particular care is demanded.

To meet every combination of stress at the point of juncture there is one type of fastener which delivers maximum performance. It is MILFORD's job to determine this "one best way". Let us supplement your skill with our fastener experience. We will welcome the opportunity of working with your production men.

The MILFORD plant nearest you will promptly and courteously interest itself in your needs.

Rivets, Screws
Screw Machine Products

The MILFORD RIVET & MACHINE CO.

EASTERN DIVISION — CENTRAL DIVISION
MILFORD, CONN. ★ ELYRIA, OHIO.

VICTORY* will mold Plastics for you...

We'll be ready to do a better molding job for you . . . when we've finished supplying the needs of many prime contractors to the Armed Forces.

Molding plastics for War still demands most of our time and equipment . . . it's VICTORY'S* bit toward complete Victory . . . but it's also paving the way for *better-molded* products for you in the days of Peace.

Wartime lessons in precision molding have sharpened the wits of our engineering staff. Solving tough problems has broadened our knowledge of handling a great variety of thermo-plastics. Our workers are better craftsmen because they have learned the importance of *extreme* accuracy.

Whatever plastic product you're planning to use, consult with our engineers at once. On certain contracts we may be able to begin molding *right now*.

Member: Society of the Plastics Industry

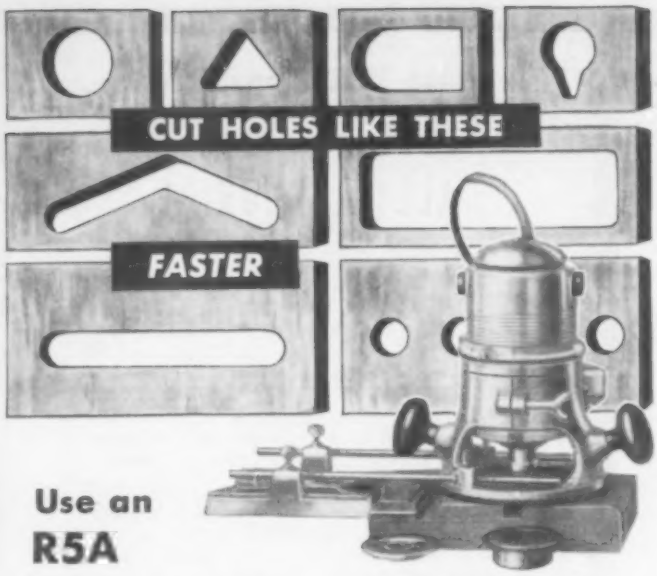
AUTOMATIC INJECTION MOLDING

Small and large parts

UP TO 17-OZ. SHOTS

Lumarith, Tenite, Fibestos, Plastacelle, Crystallite, Lucite, Ethyl Cellulose, Polystrene, Lustron, Styron, Cellulose Acetate and others . . . all molded to your exacting specifications.

*VICTORY MANUFACTURING COMPANY
1722 W. Arcade Place, Chicago 12, Ill.
ESTABLISHED 1930



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R5A

STANLEY - CARTER PORTABLE ROUTER

Routing odd-shaped holes and trimming any outside contours are easy jobs with the R5A Router. It's just the tool you need to speed work on new models or samples, and on parts made from plastic sheets, etc. A few simple attachments extend its use to hundreds of operations.

Motor unit is 1 H.P., 18,000 R.P.M. – permits smooth clean cutting. Complete details on request. STANLEY ELECTRIC TOOLS, DEPT. C, New Britain, Connecticut.

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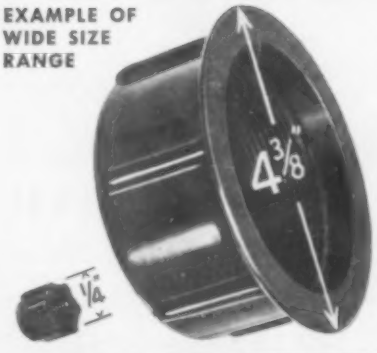
PLASTICS MOLDING
INJECTION AND COMPRESSION MOLDING IN ALL THERMOPLASTIC AND THERMOSETTING MATERIALS

EXAMPLE OF WIDE SIZE RANGE



We have the set-up and experience to give you the best in plastics molding of small and large parts, in small or large quantities, at reasonable prices.

QUOTATIONS on specific requirements without obligation

S.S.WHITE PLASTICS DIVISION
THE S. S. WHITE DENTAL MFG. CO. DEPT. A, 10 EAST 40th ST., NEW YORK 16, N. Y.
FLEXIBLE SHAFTS · AIRCRAFT ACCESSORIES · MOLDED PLASTICS · MOLDED RESISTORS · FLEXIBLE SHAFT TOOLS

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JOMAC'S LATEST CREATION — Safety *Gauntlet-Cuffs*. Now, you simply replace worn glove without the expense of buying full gauntlet.

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While our entire production is devoted at present to the war effort, we are always glad to discuss future plans.

MARTINDELL MOLDING CO.

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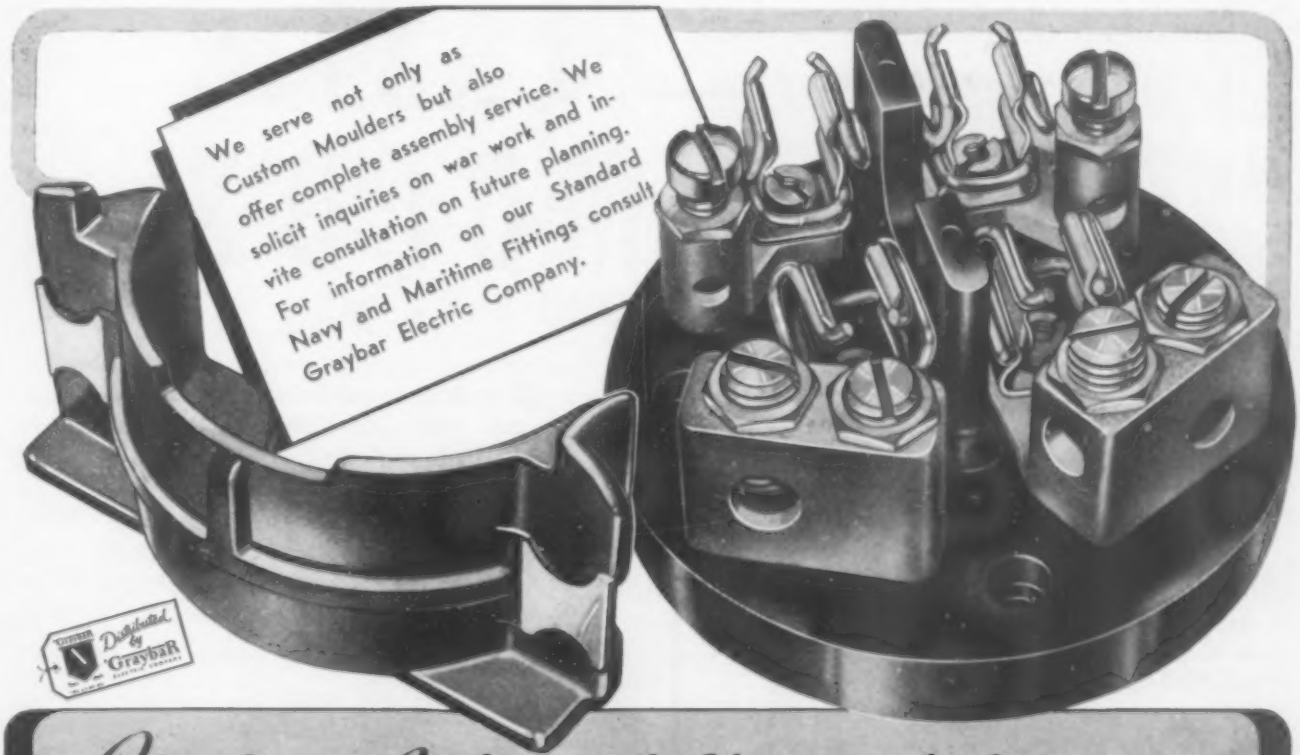
We serve not only as Custom Moulders but also offer complete assembly service. We solicit inquiries on war work and invite consultation on future planning. For information on our Standard Navy and Maritime Fittings consult Graybar Electric Company.
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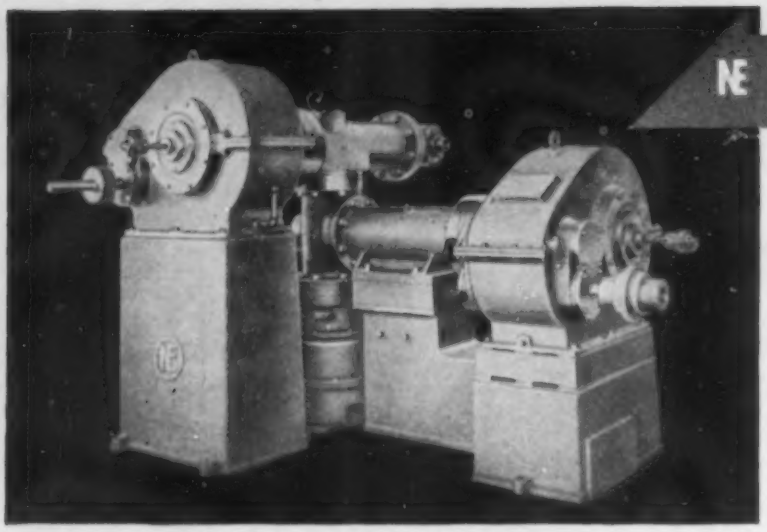

4½" NE Triple Stage Extruder with five heat control zones

NE *Triple* STAGE EXTRUDERS

National Erie engineers have recently developed a compact 3 stage extruder that offers thorough plasticizing of difficult plastics.

An independent drive is provided in each stage with progressive controlled heating.

NE Single, double and triple stage extruders permit us to offer the right extruder for the job. Consult with NE engineers.

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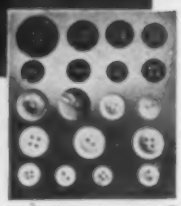
NATIONAL ERIE CORPORATION
Erie, Pa. U. S. A.

Automatic Button Finisher-

ELIMINATES MANPOWER PROBLEMS



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25 years experience in designing and building molds for leading molders.

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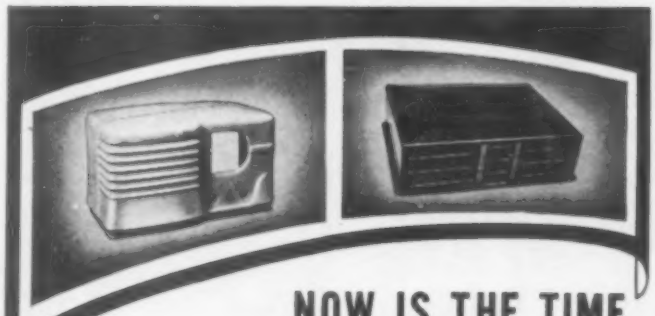

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to start post war planning and working on plastic molded parts Our engineers will be glad to call and discuss any problem having to do with compression or transfer molded parts.

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All our molds are made by men with more than thirty years experience. Our engineers offer a similar background of experience. Combined, they guarantee production of highest quality, good looking moldings on the highest possible production basis.

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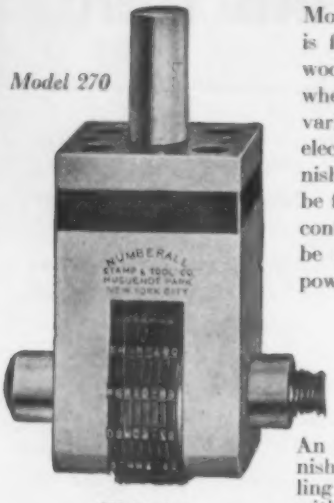
NUMBERALL

NUMBERING MACHINE FOR HOT STAMPING
MODEL 270

Model 270



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Model 270 Numbering Machine is for hot stamping on plastic, wood, etc. Any number of wheels can be furnished with various size characters. An electric heating element is furnished with the machine. Can be furnished with a rheostat for controlling temperature. May be used in any hand, foot, or power press.

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Model 223P is available with any number of steel types and in various size characters. An electric heating element is furnished and a rheostat for controlling heat is available. Can be used with color foil. May be used in any hand, foot, or power press.

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Francis
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Hydraulic
HOT PLATE PRESS

12" x 12"
18" x 18"
24" x 24"
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This general purpose press, available in a wide choice of combinations, is typical of many other Francis Presses in various frame constructions, sizes, pressures, speeds and types of pumping units, with or without electric or steam hot plates. Just tell us of your needs.

Also Roller Coaters for applying liquids or semi-liquids on any sheet materials, and special steam or electric heated mixing tanks or pots. Send particulars of your requirements.

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A complete line to meet the requirements of all types of plastics compounding. We will gladly provide laboratory assistance in helping determine plasticizers best suited to your specific problems.

Precision in production and testing assures the maintenance of exacting specifications on all our compounding materials . . . This fact can be of vital aid to you in protecting the results of your plastics production . . . Write for complete data on these materials.

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"C.A." Grade pearl essence, specially developed for use with Cellulose Acetate moulding powder.

NON - YELLOWING

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HOW MISKELLA INFRA-RED OVENS AND APPLIANCES SERVE THE PLASTIC INDUSTRY

Branch of the Industry	Name of Appliance	Use
Molders (Thermo-setting) Compression	PELLET-VEYOR (Variable heat)	To preheat pellets and preforms at the press as needed
Molders (Thermo-plastic) Injection	VIBRA-VEYOR (Variable heat)	To preheat plastic powder automatically. To dry plastic powder automatically
Injection	HOPPER-HEATER (Variable heat)	To warm up heavy metal of hopper of molding machine
Molders (Thermo-plastic) Extrusion	STRIP-HEATER (Variable heat)	To preheat strip rolls of vinylite, etc., automatically as fed to worm
Material Manufacturers	Special production Equipment including vibrators, conveyors, stainless steel belts and electronic devices	To process various kinds of plastic material in bulk
Fabricators (Miscellaneous)	BENCH-KIT In various sizes (Variable heat)	To soften sheets, rods, tubes and any shape for bending, forming punching, etc. This includes Cellulose, Acetate, Methyl Methacrylate

(The time on most of the operations mentioned above averages five minutes)
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We specialize in the custom fabrication of plastic parts of every description.

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Polystyrene
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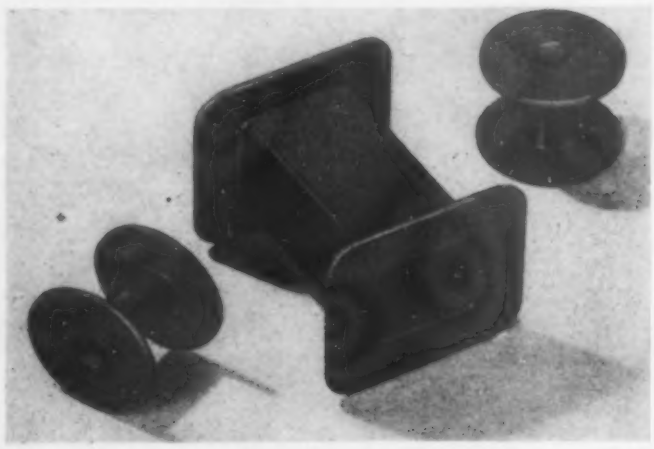

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Midwest Molding
AND MANUFACTURING COMPANY
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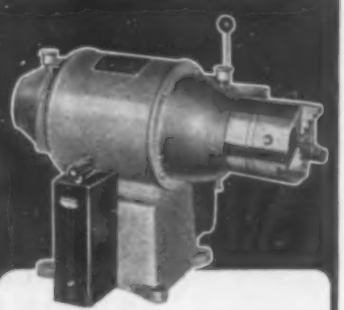
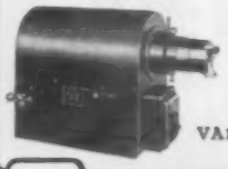
For accurate, uniform, speedy finishing of metal & plastic parts.



AWARDED October '42

NA1E

NA1C



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POLISH • LAP • DE-BURR • FINISH

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NA1E – foot-operated collet type, for high-production finishing of many identical small parts.

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VA1B – variable speed lathes, in bench and pedestal models, chuck and collet types.

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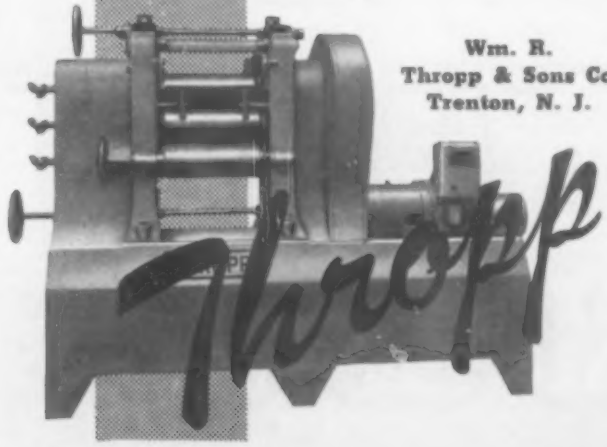

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ROCHESTER, MICH.
PLASTICS FINISHING DIVISION ★ ★ ★

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America's largest concerns have sent their buyers to investigate why it is that molded plastics products from Michigan Molded Plastics, Inc., Dexter, Michigan, are of such uniformly high quality. Furthermore, they want to know how it is possible to produce so much from such a comparatively small plant.

They come. They are amazed. They are convinced. They go back home with the knowledge that experience and "know-how" are the reasons this modest plant with its peaceful surroundings is called the "Little Giant" of the plastics industry.

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COMPRESSION · INJECTION · EXTRUSION

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. . . So writes Arthur A. Schwartz, chief tool research engineer of the Bell Aircraft Corporation.

The dispatch with which these machines are cutting plastics of all types as well as metal, formed or flat, 1-inch armor plate and a host of other materials, is so spectacular to some that they refuse to believe their own eyes. By all means get acquainted with them. Write for your free copy of "FRICTION SAWING" — by Arthur A. Schwartz.

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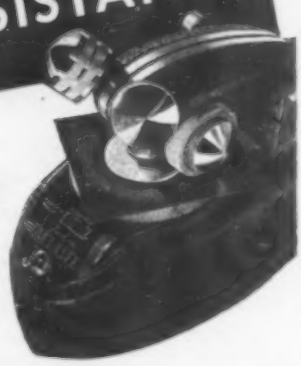

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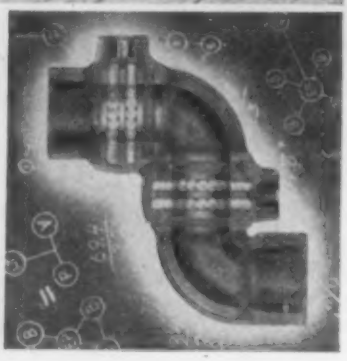

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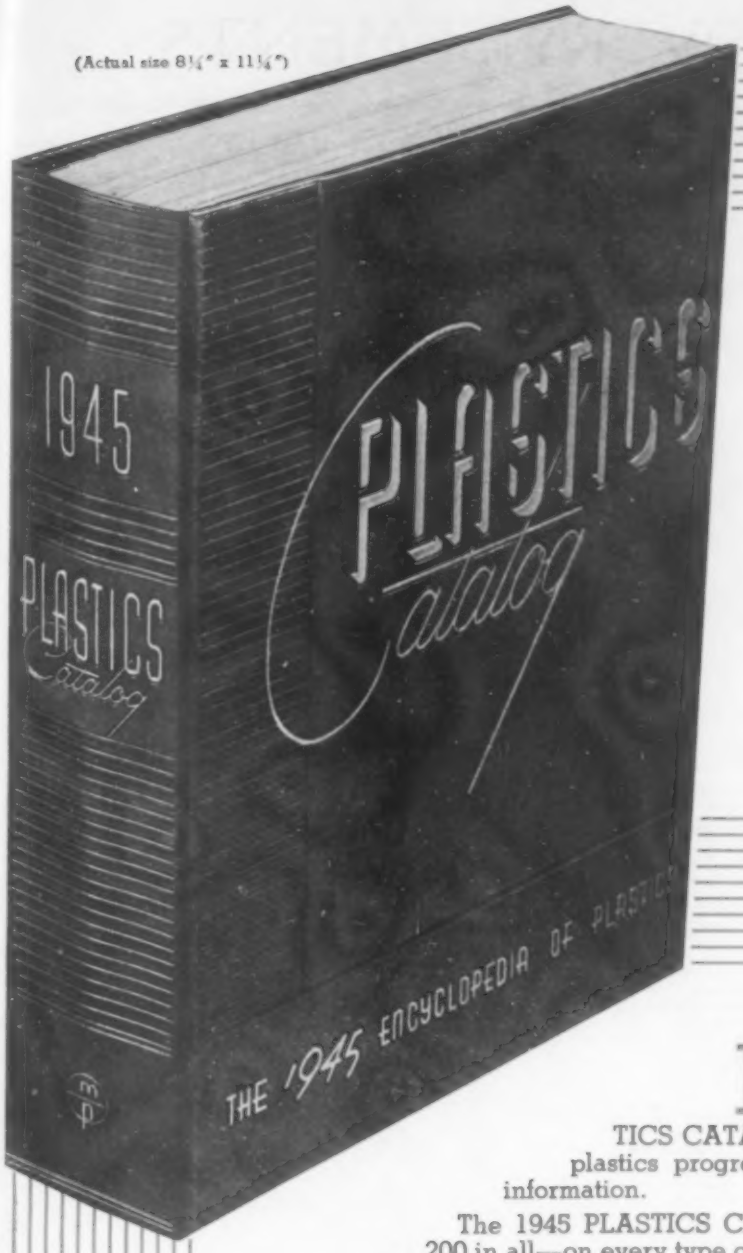

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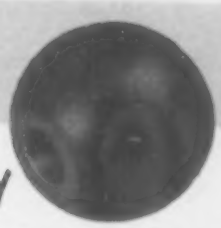

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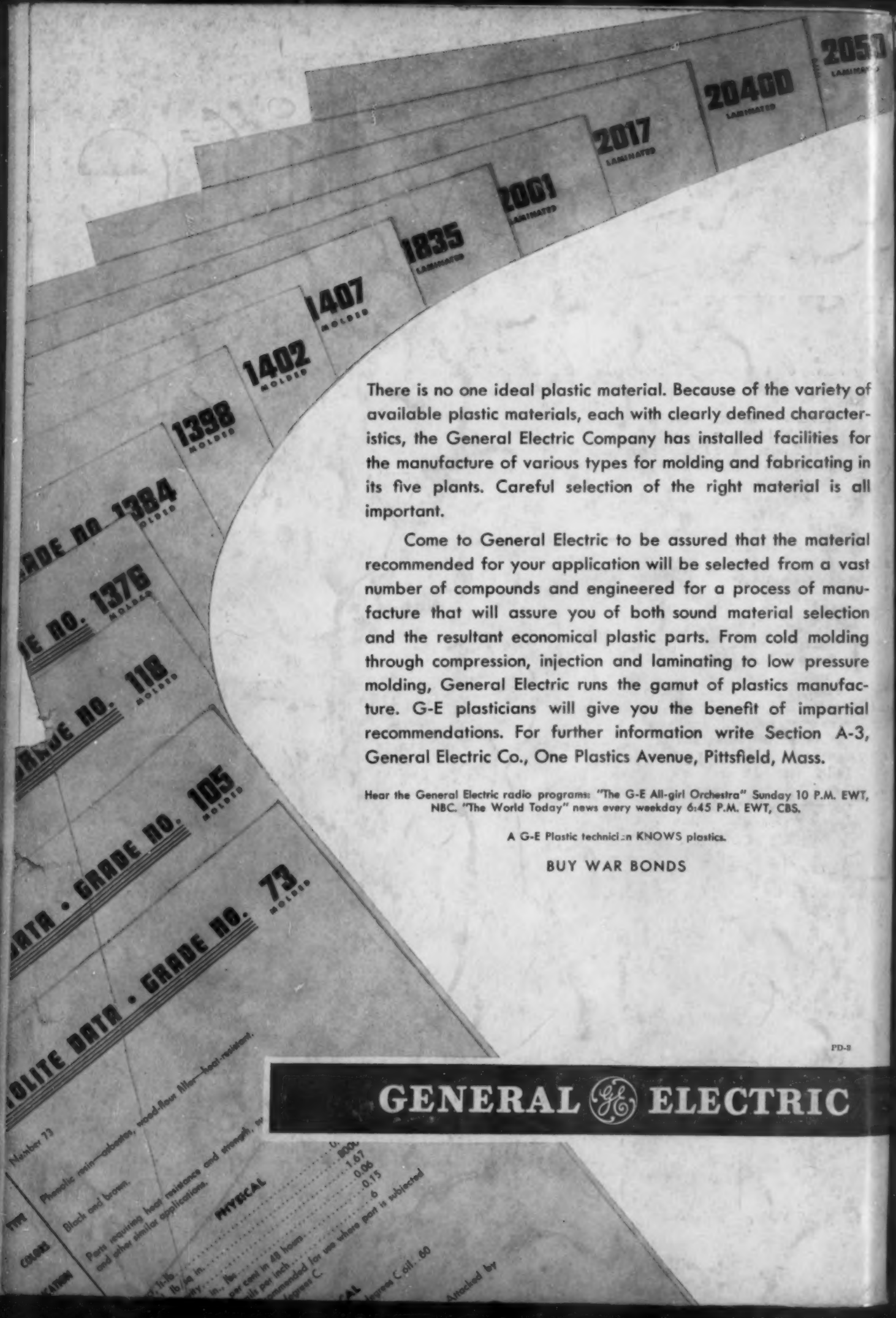

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